INSECT LIVES

AS TOLD BY THEMSELVES

GOAT MOTH.

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AS TOLD BY THEMSELVES

'O Lord, how manifold are Thy works!
In wisdom hast Thou made them all.'
Ps. civ. 24.

BY
EDWARD SIMPSON

WITH TWENTY-THREE ILLUSTRATIONS

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Preface

THE present is an age of 'Autobiographies' and 'Reminiscences.' Celebrated men and women, from time to time, tell the story of words and deeds in which they have taken part. There is something very pleasant in these books; for, as we read them, we seem to have the whole scene brought vividly before us, and with more reality than if they had been taken from the pages of an ordinary biography. We propose to extend these 'Reminiscences' to the Insects, and thus make them tell the story of their own lives.

The idea of making the lower animals, or even plants, talk so as to be understood, is not new. So far back as B.C. 1209, in the days of Jotham (Judges ix. 7–15), we read of trees being on the look-out for a king to reign over them; and the Bible gives the conversation that took place between the olive tree, the fig tree, the vine, and the bramble.

The writer hopes that, by making the Insects tell their own tale, his readers will be led to take greater interest in them; and that the history thus told will remain in the memory of the young readers for whose benefit they are printed. At the same time, as *every*

insect has some particular point of interest not possessed by others, his readers may perhaps be led to examine these and other insects, and thus learn how wonderfully all are adapted to that mode of life for which God designed them.

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Introduction

INSECTS form one of the classes of animals not having a backbone. Their bodies are articulated or jointed, and are made up of a series of rings, forming three divisions of the body more or less distinct—the head, the thorax or chest, and the abdomen or body. It is from their being thus divided that they derive their name, *Insect*—the Latin word *Insecta* meaning 'cut into.' These divisions are very clearly seen in the wasp and fly. In their adult state they have three pairs of legs, and whilst some do not possess wings, others are provided with four or two.

But before reaching this state, some of them pass through a series of changes or *metamorphoses*; others do not undergo any clearly marked change. Insects generally come from eggs, and, when hatched, those that undergo changes are so very unlike what they will be in the adult state that they are called *larvæ*, from the Latin word signifying a mask, because their future form is more or less 'masked' or concealed. They are popularly known as caterpillars, grubs, and maggots. A *caterpillar* is the larva of a butterfly, moth, or sawfly. It is often hairy, and has three pairs of legs for walking, and others, which help to keep its body off the ground, and also enable it to hold on to twigs or leaves when feeding. A *grub* is the larva of a beetle, and has three pairs of legs and a smooth body; and a *maggot* is the larva of a fly, bee, or wasp, and has no legs. But it

will be better not to speak of them under these names, but to call them all *larvæ*.

After moulting, or changing their old skin for a larger one, which they do several times, they undergo an important alteration. In this state many insects are motionless, or nearly so, and take no food, whilst others are active and voracious. They are now called *pupæ*, from the Latin word *pupa*, meaning a baby or doll; because in this condition Linnæus, who gave them this name, considered them to resemble an infant wrapped up in swaddling clothes, as commonly seen on the Continent. Popularly, each pupa is called a *chrysalis*, and a number of them *chrysalids*, from a Greek word alluding to the *golden* lustre of the pupa-case, which is composed of silk spun by the larva.

In the third or last stage, having arrived at the adult state, the insect is known as an *imago*, or perfect insect. It is now exactly like, or is the 'image' of, its parent. It grows no more, all its growing having been done in the previous stages. It has now usually either two or four wings, although there are some that have none at all. The active but very irritating little creature, the flea, is an example of a wingless insect, the wings being represented by four minute scales at the sides of the body.

By means of differences in the number and structure of the wings, insects have been divided into thirteen orders, as shown in the Table. The names of these orders are all formed from the Greek. The termination, in every case, is 'ptera,' or wings, whilst the first part of the word gives some idea of the leading features of any particular order, which will be seen as we proceed.

CLASSIFICATION OF INSECTS.

	Order.	Meaning of Term.	Species described
			Chapter
Wings — Four — Two covered when at rest. The front wings — Not overlapping at the tips — Hinder pair entirely covered	Coleoptera	Wings in a sheath	1–4
Wings — Four — Two covered when at rest. The front wings — Not overlapping at the tips — Hinder pair partially covered	Euplexoptera	,, beautifully folded	5
Wings — Four — Two covered when at rest. The front wings — Overlapping at the tips	Orthoptera	,, straight	6, 7
Wings — Four — All visible — Covered with coloured scales	Lepidoptera	,, scaly	8, 9
Wings — Four — All visible — Not scaly — All the same size — Extended when at rest	Neuroptera	,, like nerves	10
Wings — Four — All visible — Not scaly — All the same size — Partially extended when at rest	Trichoptera	,, hairy	11
Wings — Four — All visible — Not scaly — All the same size — Laid along the back when at rest	Thysanoptera	,, fringed	12
Wings — Four — All visible — Not scaly — Anterior pair, the larger — Mouth formed for biting	Hymenoptera	,, like membrane	13
Wings — Four — All visible — Not scaly — Anterior pair, the larger — Mouth formed for suction — Anterior pair not overlapping	Homoptera	,, alike	14
Wings — Four — All visible — Not scaly — Anterior pair, the larger — Mouth formed for suction — Anterior pair partially overlapping each other	Heteroptera	,, different	15
Wings — Four — All visible — Not scaly — Posterior pair, the larger	Strepsiptera	,, twisted	16
Wings — Two	Diptera	,, two in number	17, 18
Wings — None—represented by minute scaly plates	Aphaniptera	,, not apparent	19

I

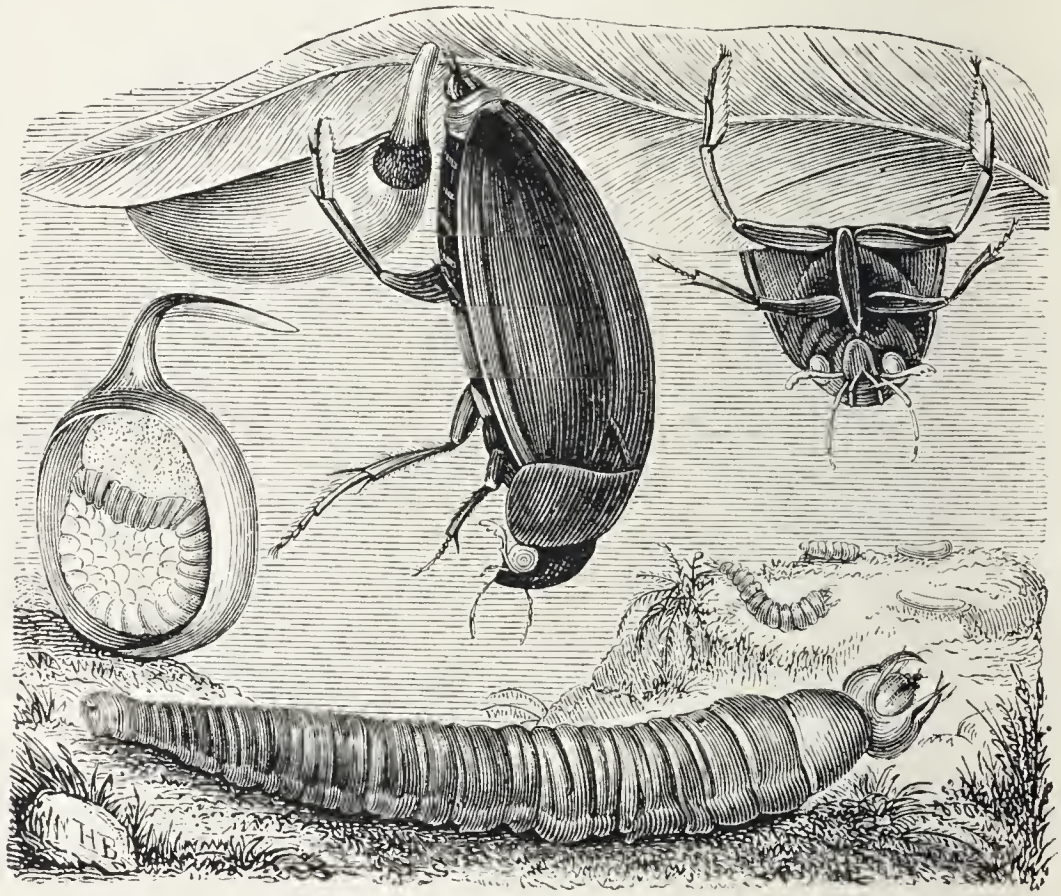
The Autocrat of the Pond

The Black Water Beetle (*Hydrophilus piceus*)

STANDING one fine morning by the side of a clear pond well stocked with various kinds of water-plants, we noticed, quietly crawling about on them just below the surface, a large black beetle, about one inch and three-quarters in length, and three-quarters of an inch across its back. It ocasionally came up to the surface to take in a fresh supply of air, and then, as it slowly went below again and turned its under side towards us, we saw that it had all the appearance of a large globe of quicksilver. Being anxious to know more about this fine inhabitant of the pond, we waited until he re-appeared, and then addressing him in our politest manner, we requested him to kindly grant us an 'interview,' and tell us something about his life in the pond. To this he readily consented, and immediately commenced as follows:—

'I am usually called the Black Water Beetle, but strictly speaking my colour is olive-black. There is a relation of mine here who goes by the name of the Great Water Beetle, but this is rather misleading, as you might suppose that he was the larger of the two, when such is far from being the case. I believe I have

the honour of being the largest water beetle known, exceeding in size even those living in tropical countries. My length is about one and three-quarter inches; Old Dyticus is about one and a quarter inches. On the other hand, I should say that some of my family are very minute. I generally remain in the pond all day, but occasionally sit upon a plant by the water's edge;

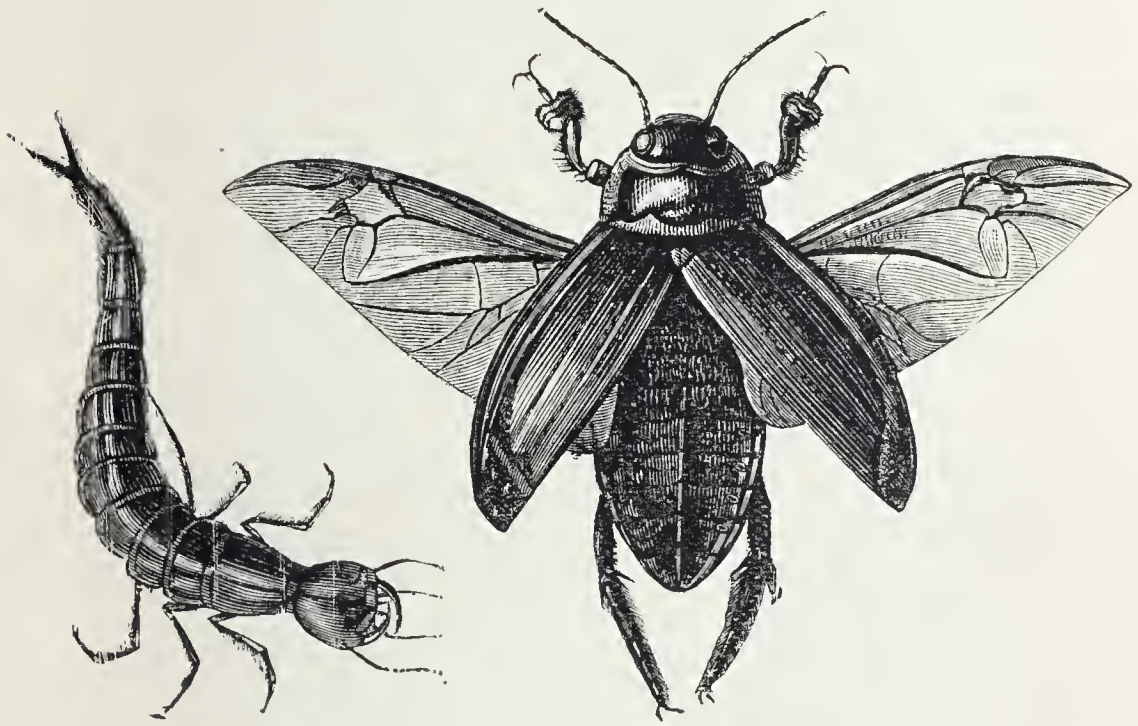


BLACK WATER BEETLE.

at night, however, I make short excursions abroad. It is probably in consequence of my being most frequently seen in the water that I have received the name of Hydrophilus, or "water-lover." At the same time there are many others equally fond of the water who do not belong to my family.

'I commenced life in this pond. My mother took great care in providing for my future welfare. I had

fifty or sixty brothers and sisters, and the eggs which contained us were enclosed in a cocoon, or bag, lined with fine silk of a delicate white colour and coated externally with a gummy secretion, which became hard and impenetrable by the water, and thus kept us all dry. The silk was spun by spinnerets at the end of my mother's body, and the cocoon, which was shaped very like a turnip, was about one inch broad, and was attached to the under side of a leaf, or some floating ob-



GREAT WATER BEETLE.

ject. One side was provided with an upright, bent horny point, an inch in length, which, as it projected above the water, was long supposed by some of your learned men to act as a sail, but it is not until we have left the cocoon that it floats freely about upon the water; its real use was to convey air to us during the time we were in the cocoon. Inside we were all arranged regularly and in an upright position, and so remained for about a fortnight; but some of my rela-

tions have been known to remain as long as six weeks, when the weather was cold.

'On escaping from the egg as larvæ, we all retired to the lower part of the cocoon, and there remained twelve hours, until the pangs of hunger caused us to make our way through the thin silk at this part of the cocoon and then drop into the water. We grew rapidly, and were in a very short time twice as long as the egg from which we had so recently escaped. The empty cocoon might be seen, after our departure, floating about on the surface of the water. We moulted, that is, changed our skin, three times. After the first change we were about an inch long; after the second, one and a half inches; and after the third, which was in July, we were about three inches in length, and were of a dark brown chocolate colour. We were somewhat conical in form, and fleshy, with short, slender legs; and our body was terminated by two short hair-like appendages by which we breathed. Our head was horny, and, I must confess, was rather singular in shape, being rounded underneath, and flattened above. Our jaws were remarkably strong and elevated, and had a tooth near the middle of the inner edge. From the position of our head and jaws, we were able to seize our food, which consisted of small snails and other animals inhabiting the water. On being caught by our mandibles (or jaws), a clever jerk of our head threw the animal upon our back, which thus served as a convenient table for its support.

'Having now become full grown, my appetite, which had hitherto been very great, suddenly fell off, and I gave up eating entirely, and commenced thinking about preparing for my next stage, that is, the pupa condition, which I knew was close at hand. Then I left the water and burrowed into the soft bank, and there, at a depth of two inches, I had in about five days constructed, by

the assistance of an organ at the end of my body, an oval cell to protect me. It was three-quarters of an inch in length, and without any opening. In ten days my change was completed, and thus I remained for three weeks. Then I began to release myself from the covering in which I was enclosed, and having done this, I rested for the next twelve days. The various parts of my body had meanwhile become so hard and strong that I was able to force my way out of my cell. I was now in my perfect or imago state, and lost no time in returning to the pond where I had spent so many happy hours in days gone by.

'My age at this period, so far as I can calculate, was about 108 days, my time having been passed thus—

60	days	in the egg and as a larva.
5	„	constructing my underground cell.
10	„	changing to a pupa.
21	„	in my pupa condition.
12	„	resting underground after entering my perfect state.

Total, 108 days.

'I have now two large wings carefully folded up under and protected by these horny cases, or elytra, hence the name of my order, Coleoptera. The under surface of my body is thickly coated with hairs, and on my coming up to the surface of the water a portion of air becomes entangled among them, and also under my wing cases, and then passes through small openings on my body to fine tubes, or tracheæ, which convey it to the various parts of my body, and so my respiration is carried on until this air having become impure, I am again obliged to ascend to the surface for a fresh supply.

'I have some cousins living with me in this pond, but we keep very much to ourselves; one of them is the so-called Great Water Beetle (*Dyticus marginalis*)—Old

Dyticus," as we call him. He is a terrible fellow. There he goes. You see he is only about half my size, but he is very strong and quarrelsome.

'In his earlier days he and I much resembled each other, but he was yellowish-brown in colour, and his body, both in shape and to the touch, was more like a shrimp, by which name he is sometimes known. He had two very powerful jaws, and it was well to keep out of his way; he would attack even fishes or newts, and I am sorry to say he has no respect even for his own immediate relations. Even now he is not much better. He can swim very quickly, probably being helped by having the three front joints of his forelegs flattened, so as to form a circular disc, or kind of paddle. As you see, I also have one, but it is much smaller. He has to come to the surface for air, but he has not that shining appearance underneath; what air he wants he carries between his wing cases and his back. I have other relations around me who are very small, but you will never see them any larger, as their growing days are past.'

We thanked Hydrophilus for the interesting information he had given us; then he dived, and we lost sight of him among the leaves of the aquatic plants.

II

The Merry Dancers

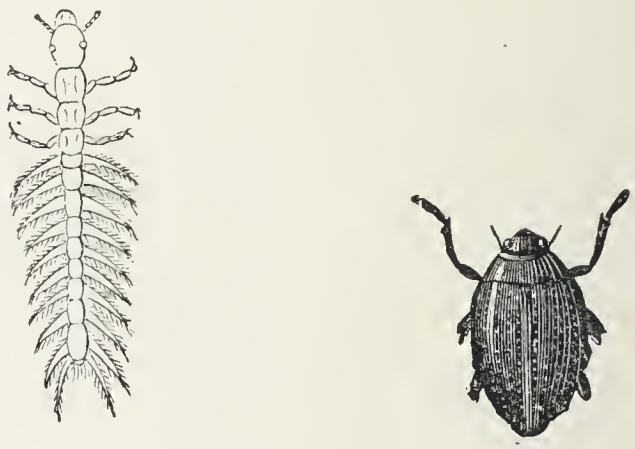
The Whirligig (*Gyrinus natator*)

WHILST listening to the interesting story of the life of the Black Water Beetle, we noticed in one corner of the pond a group of little creatures whirling about in every direction, but so swift were their motions, that our eyes could scarcely follow them, and this was rendered still more difficult owing to the dazzling brilliancy of their wing cases, which glittered in the sun like polished steel. As we approached nearer to them, they took alarm, and dived beneath the surface of the water. Presently they came up again, and continued their merry dance apparently as fresh as ever. It was some time before we could engage the attention of one of them, but at last we succeeded, and were then so fortunate as to induce him to tell us something about himself. He began thus :—

'I have the honour of belonging to the same order (Coleoptera) as the Black Water Beetle. In consequence of our peculiar motions on the surface of the water, which perhaps appear to you to be of a very frivolous nature, but which are really connected with the way in which we obtain our food, we are popularly known as Whirligigs, or Whirlwigs. The French call us Tourniquets, but we are known among the learned folk as *Gyrinus*

natator. There are, I think, a few circumstances in our history that may prove interesting to you.

'My earliest recollection is finding myself crawling over the leaf of a water plant, having just escaped from the small cylindrical egg, which, with a number of others, had been placed by my mother end to end upon the leaf of a plant in parallel rows. I had been in the egg eight days before I was in a state to leave it. My appearance as a larva was certainly very remarkable. I was long, narrow and flattened, and I believe very much resembled



WHIRLIGIG BEETLE.

a small centipede. My colour was whitish. My body was composed of thirteen segments, or parts, of which my head formed one, separated from each other by incisions at the sides. My head was large, and provided with two powerful jaws. I will tell you something about my eyes by-and-by. On each of the three front segments of my body was a pair of legs, and from each side of the next eight joints there was a long slender filament bent slightly backwards and ending in a point, and on the last joint were two pairs of these filaments, but they were rather longer. All of these were useful to me as breathing organs—each of them having inside them a delicate air-vessel, connected at its base with another one, called

a trachea, or windpipe, running down the side of my body internally. As I swam through the water the air dissolved in it was extracted from it, and was thus made use of for respiration—just as you may have noticed in fishes. The filaments were also of some little help to me in swimming, but the four minute conical points, bent downwards at the extreme end of my body, were the principal means by which, at that time, I swam.

'About the beginning of August I was full grown, and then crept up the stem of a water plant; until I was several inches above the surface of the water. Having selected a safe and comfortable place, I enclosed myself in an oval cocoon of my own spinning, somewhat resembling grey paper in appearance. Inside this I passed into my next stage (that of pupa), and so remained about a month, when I broke through my cocoon and appeared in my perfect state, as you now see me, and once more entered the water.

'I have a strong, firm body, and large powerful wings (the two pairs being constructed like those of the Black Water Beetle), which I occasionally use in flying from one pond to another. I cannot fly straight away from the water, but have to crawl up the stem of a plant, and start from thence. I swim about in search of my food, which consists of small dead floating insects, or others which may fall upon the surface. During the winter months we keep ourselves warm in the mud at the roots of plants, sometimes coming out, if the weather is warmer.

'To enable me the better to obtain my food, I am provided with eyes specially adapted to my mode of life. I have two large eyes, but each of them is divided by that part of my head which carries my antennæ, or feelers, and they are so constructed that half of each eye is out of the water, and enables me to see objects above

it; whilst the other half is beneath the surface and enables me to see objects below—thus I have in reality four eyes. Not only are they of valuable assistance in looking after my food, but they also are of great service as a means of protection against my enemies. I have another means of defence, as I carry about with me a milky fluid which has a very disagreeable odour. This fluid I can emit when attacked, and I have on many occasions proved its utility.

'With the exception of a few members of my family residing in tropical countries, who attain a length of nearly one inch, we are all about one size—that is, about one-third of an inch in length. Our habits differ—some of us live on the margin of the sea, another resides near the summit of Mount Etna, in the region of perpetual snow. I have also another eccentric relation, *Orecto cheilus*. He is of a retiring disposition, and does not like the light; but during the day he and his friends hide themselves under stones on the banks of rivers, only coming out at night to feed. Nor is he partial to water. If forced into it, he never dives, but tries to gain the shore as quickly as possible. His personal appearance is very unlike mine. The upper part of his body is black, and is covered with short greyish down—whether this may serve as an overcoat to keep him warm I am not able to say. I think I have now given you an account of the chief points of interest in my life history; it therefore only remains for me to thank you for your kind attention and wish you "Good morning."'

III

A Successful Trapper

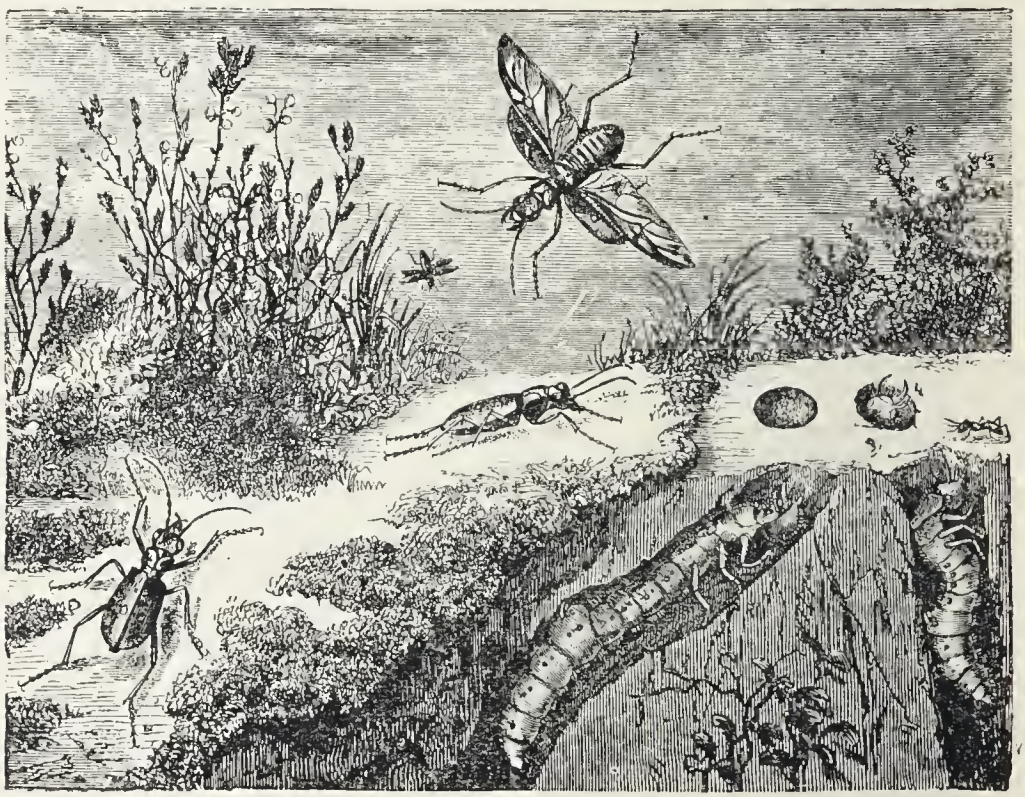
The Tiger Beetle (*Cicindela campestris*)

IN one of our walks on a bright sunny day we noticed an insect flying about with great swiftness. Its flight was of short duration; but on our approaching it, when it had settled, it immediately took wing again. It was a beautiful beetle, rather more than half an inch in length, of a dullish green colour, with several yellow spots on its elytra, or coverings of the wings. When we had succeeded in capturing it, we perceived that it had a pleasant scent, somewhat resembling that from roses. In accordance with our usual custom we requested him to give us a short account of his life, to which he readily consented.

'Although I am afraid that the name Tiger Beetle, by which I am generally known, is not a very attractive one, but may rather have prejudiced you against me, I would humbly hope that my personal appearance will convince you that however tiger-like I may be in my own sphere, I am perfectly harmless as regards you. Perhaps my less familiar name of Sparkler may be more acceptable to you. My life, particularly the earlier part of it, has been a remarkable one, having been passed in an underground dwelling, where I supported myself as a "trapper." At the present time I obtain my food

either by flying after my prey from plant to plant, or by running after them on the ground. This I do with such rapidity that I doubt whether your eyes can clearly follow my course. But you will probably like to hear about my earlier days.

'A sandy heath, or some similar place, is that always selected by our mothers in which to deposit their eggs.



TIGER BEETLE.

This is done for two reasons, one being that as soon as we escape from the eggs, as larvæ, we find ourselves in a suitable place in which to construct our burrow; and the second reason is, that these sandy heaths are the favourite resorts of the animals upon which we subsist, so that we, as trappers, find ourselves from the very commencement of life in the midst of a well-stocked and "happy hunting ground."

'In our larval state we cannot call ourselves hand-

some, either in form or colour. Our body is long, more or less round, and hump-backed, and of a whitish colour. It is divided into fourteen segments, including the head and tail; the ninth segment is much larger than the others, and has on it a pair of bent hooks, placed upon a retractile protuberance, which is crowned with reddish bristles. Our head is large and horny in its structure. Our jaws also are very powerful, and are especially designed by the Creator for our particular kind of life.

But before describing them I will say a few words about my burrow. This is made in the sand, and would perhaps be better described as a deep, narrow pit. It varies in depth, being usually from six to nine inches deep; but some of my relations on the Continent make their burrows, I believe, as deep as eighteen inches. Whatever the depth may be, it is in all cases a little wider than the diameter of our body. Our mode of working is to loosen the sand by means of our legs and jaws, and to allow it to rest upon our broad saucer-like head. It is then carried to the surface by the assistance of the two hooks I have mentioned, and is thrown aside.

The pit or burrow is generally perpendicular, but it is sometimes necessary to alter its shape in consequence of a stone or a root coming in the way; and not infrequently the obstacle is such, that we have to abandon the pit and commence a new one. This being finished, we station ourselves at its mouth, holding on by means of our legs, and the two hooks on our back, which catch into the side of the burrow and keep us from slipping down, whilst our large head just fills up the entrance, and forms a kind of trap-door. Here we rest quietly, waiting for our prey to approach, which, not noticing our head, walks over it. We immediately withdraw into the burrow, and before our prey knows what has happened, he is seized and dragged down to the bottom,

where we enjoy our dinner in quietness. Our jaws are admirably adapted for the work they have to do. They are not placed horizontally, as you usually see them, but are raised like the tusks of an elephant, so that any animal falling into the pit, as I have described, can be the more readily seized. It is very rarely indeed that one escapes, or that we have to make a second attempt.

'In course of time I attained my full growth—about June—when I closed the entrance to my pit, and made preparation for my change; and in the course of a few days I reappeared at the surface in the form in which you now see me. My burrow is no longer needed. With the aid of my newly-acquired wings, the construction of which places me amongst the Coleoptera, and with my active legs, I can easily capture my food. I have little to do now but to find a place suitable for my family, some of whom you may possibly meet during August and September.'

Having detained the Sparkler so long, we thanked him for the information he had given us, and then had the pleasure of seeing him fly away to enjoy his well-earned dinner.

IV

The Gardener's Friend

The Ladybird (*Coccinella septem-punctata*)

IT is summer, and we are walking in our garden, and are admiring the flowers now appearing so abundantly on all the plants. As we pass one we catch sight of a very favourite little beetle, very small, but beautifully marked, and well known to everybody, we should think. It is a Ladybird, and its name will at once enable us to picture it. It is a beetle that varies much in colour, and in the markings on its elytra, or wing cases. In the one we are looking at, these elytra are scarlet, and in the centre of each of them is a black dot. There are also two more on the outer side of this central one, and one on the upper part where the two elytra meet; and it is from these seven black dots that it has derived its name of *septem-punctata*, to distinguish it from its cousins, *bi-punctata* (two-spotted), and others. Let us now see if we can get any information from our pretty little friend. We are successful, and the ladybird thus commences her story :—

'In complying with a request to give a sketch of my life story, I have the greater pleasure in doing so, knowing, as I cannot fail to do, that I am regarded with favour by your race generally, not in this country only, but wherever we live, and I feel an honest pride in

stating that this is the case specially among my younger friends, whose treatment of other insects is not always of the kindest nature. Your poets also have made our name very familiar, and many a time have I heard the well-known lines :—

> "Ladybird, ladybird, prithee begone!
> Thy house is on fire, and thy children at home."

'I may just add that the poet is not quite correct here, as we never live in homes, and therefore are never exposed to the danger of which he speaks. This regard for us probably arises from two causes. With my young friends it is perhaps from admiration of our personal appearance, and from the entire absence of anything unpleasant in our manner towards them; whilst with my older friends it is probably due to the assistance we render to them, particularly to those who love flowers, by destroying some of their most destructive enemies, and thereby preserving to them that which would otherwise be hopelessly lost; but of this I shall speak hereafter. Few people are aware of the number of my relations (*i.e.* cousins and others) inhabiting this country. I have no less than thirty.

In outward appearance we vary greatly, the difference consists in the colouring of the horny cases (or elytra, as they are technically called) which cover and protect our wings. Thus, in some of us, the chief colour is red spotted with black, or black spotted or marked with red; black spotted with yellow, or yellow variously marked with black, and so on in great variety. We occasionally appear in vast quantities in some parts of the country, and it is quite impossible for me to give any idea of the number. In 1807 my ancestors visited Brighton, and all the watering-places on the south coast, in such enormous numbers that the shore was literally covered with them. But these visits only occur at

LADYBIRD.

distant intervals, and it is perhaps well for our sakes, as well as yours, that they are not of frequent occurrence.

'I will now give you an account of my life. During the winter we hybernate, that is, we sleep away the time in the crevices of palings, trunks of trees, under loose bark, in dry leaves, and many other places; but we are sometimes tempted to come out and stretch our wings on a sunny day, even in December. We all come out, however, very early in spring. Our first appearance in the world was in the form of eggs, and as many as fifty of us, brothers and sisters, were deposited by our mother close together in little clusters under leaves, in the midst of the food which we should require after we had issued from them as larvæ. In shape the eggs were cylindrical, buff-coloured, and set on one end.

'From these we issued as little sprawling creatures, of a lead colour, gaily ornamented with orange or scarlet spots, and at once spread ourselves over the leaves and elsewhere, where our food was to be found; of what this consisted I will tell you presently. In about a fortnight or three weeks we were full grown, and were from one-quarter to one-third of an inch in length. At this time we were slate-coloured and yellow, with numerous black spots and hairy tubercles down the back, mixed up with a few scarlet spots. We retired to a leaf, or some safe retreat, and securing ourselves by our tail, head downwards, we assumed our next form—that of the pupa—inside our larval skin. We were now shining black, with a row of orange spots down the back. At the end of a fortnight or three weeks, the larval skin split down the back, and I soon appeared as you now see me. As I belong to the order Coleoptera, you know, my two wings are folded up under these hard covers (elytra).

'It is time now that I told you something about my food. It is this, especially in my larval state, which causes me to be such a valuable friend to the gardener and others. My food consists of a very small creature called the *aphis*. There are a great many of the same family living on various plants, and which increase in a manner perfectly astounding. The damage they do is very great, and were it not for us, and my friends the ants, and others, some plants and shrubs would be almost entirely destroyed. The aphidæ live in great numbers; in hop gardens in myriads. If you ever saw any of my relations in the larva state you would hardly imagine that such dull, quiet-looking creatures could do so much good, but the aphides soon find out, for although the plants may be swarming with them, in a day or two they will be all cleared off. In my present state I am still able to render you great assistance. One of your writers, speaking of two of my ancestors, says, "that in twenty-four hours they cleared two geranium plants of these destructive creatures." It is, however, especially in those parts of the country where hops are cultivated, that my services are so invaluable. It is here that the aphides abound in such numbers that they have been known to destroy whole plantations in a single season, thereby causing the greatest distress amongst those persons whose living depends in one way or other upon the hop, and here it is that we also live and assist in destroying them.

'As no words of mine can give you the faintest idea of the vast number of aphides, and the extraordinary way in which they increase, I think it may interest you to tell you of a calculation that was made by Professor Huxley. I merely give you the result, and will not trouble you with the long calculation, which you can find at length in Mr. Buckton's *Monograph of British*

Aphides, vol. i., p. 80. First, suppose that *one* aphis lives 20 days, and at the end of that time produces 20 young ones, then at the end of 300 days only, the number of aphides living would amount to 32,768,000,000,000,000,000! (or 32 trillions 768 thousand billions). Further suppose that 1,000 aphides weigh 1 grain, and that a stout man weighs 2,000,000 grains, then the weight of all these aphides would be equal to that of 1,638,400,000 stout men, that is, equal to four times the population of the Chinese Empire!

'But large as this calculation is, it is said to be very much *below* the actual amount, and that at the end of 300 days there would be so many living that "there would be room in the world for nothing else but aphides"!' (Here the Ladybird ceased, as if overcome with the overwhelming magnitude of the calculation; then, raising her elytra, she unfolded her wings, and was soon lost to our gaze.)

V

A Devoted Parent

The Earwig (*Forficula auricularia*)

HORTICULTURISTS have no affection for the subject of our next life. In roses, dahlias, pinks, and many other flowers, it lives among the petals, feeding upon them, and other parts of the plant. It also has a partiality for fruit, seeds, and leaves ; indeed, it is not particular in the selection of its diet. It does most of its work in the dark, and is not very frequently seen abroad in daylight ; but we can at any time find one without expending much time in the search. And although there is a general dislike to it we shall find that, like other insects, it can tell us something that will interest us. Let us try—but first of all we must catch one. Doubtless, this rose which 'has seen its best days,' is now forming the residence of one or more. Ah ! here is one ! We state our wishes, and in compliance with them, she consents to tell us something of her history.

'I am too well aware that the very sight of me, or the mere mention of my name, has caused some of you, especially the ladies, to give an involuntary shudder, as though I were a monster, or some spiteful creature, determined upon doing them some injury. This no doubt arises in a certain degree from my name, and I must therefore be allowed to protest against being called an *Earwig*.

Ignorant people have an idea that the main object of my life is to crawl into their ears; and that, unless my existence is speedily terminated, the remainder of their own will be passed in misery—affecting their brain, causing madness, and intolerable agony! This ignorance is very prevalent, and I believe nearly every European language has a word of similar hateful meaning. The French call me Ear-piercer (*Perce-oreille*), but I should say that a recent author derives it from the forceps at the end of my body resembling the

EARWIG.

instrument used for piercing the ears for the insertion of earrings. The Germans call me Ear-worm (*Ohr-wurm*). Here the two parts of the word have some connection with each other, but in your language it is quite the reverse. One fails to understand the meaning of earwig. How this is in any way associated with me, it is quite impossible for me to say. Had those who gave me this name ever taken the trouble to examine me, they would not have displayed such ignorance; they would have discovered that my proper and correct name is Earwing, and that, because my wings, when unfolded, have a strong resemblance to your ear. But, perhaps, after all, you did not know that I had any wings. That is very likely;

and I think that among all your friends you will not find half a dozen—no, nor half that—who have ever seen them. I shall have more to say about them later. In future I hope you will give me my proper name, and will also bear in mind that your ear is about the last place in the world in which I should ever wish to live; and did I accidentally get in, you may depend upon it my great desire would be to get out again as soon as possible.

'My relations in this country are but few in number. One of them resides on the sea coast, amongst the rocks during the daytime, coming out after sunset. He is a giant compared to myself, and should you ever see him you may consider yourself very lucky. But now as to my life.

'The egg from which I came was placed in company with about fifteen or twenty more, containing my brothers and sisters, in a cavity in the earth, beneath a stone, and our mother was very careful to select a moist situation. Contrary to the custom of my fellow-creatures, she did not leave us there, but sat upon us and kept us warm, leaving only to get her food. This was early in summer, and about the middle of June we were all hatched. At first we were white, and very small, but active. Our mother took great care of us, brooding over us as you have seen a hen with her chickens. For the first few days after our birth, she fed us, and after that took us to the plants in the neighbourhood. We had a strong resemblance to our parents from the first day of our birth, but had no wings, and our forceps were not so large as you now see mine. As we increased in size we changed our skins, *i.e.* moulted, several times, and at the last change our wing covers first made their appearance.

'We were now in our pupa state, but continued as active as hitherto. At my final change, my wings were

fully developed. These are very large, and are packed up, with the exception of a small portion at the tip under these small covers, in a manner truly wonderful. I do not suppose any of you have seen them, so I will now expand them, and you will be astonished, and wonder how they could have been packed up in such a small space. It is owing to this that the order to which my family belongs is called Euplexoptera, which is the Greek for "beautifully-folded wings."' (Saying this she expanded her wings.)

'You now see the resemblance each wing has to the shape of the human ear, and so can understand why I should undoubtedly be called an *earwing*, and *not* earwig. The membrane of which the wings are composed is very delicate. The front margin, from the base to about half-way along it, is rather hard and firm. There you notice a broad leathery patch. This is the point which is not protected by the elytra when my wings are at rest, and hence it was made stronger and firmer than the rest. Besides this, it acts as a hinge, and is also the point from which numerous veins radiate, like the folds of an open fan, and at half way in their length the edge of each of the folds is strengthened by a small patch of a leathery material, which forms a small hinge. There are also shorter veins extending from the middle to the posterior margin of the wings. When I wish to close them, the radiating veins or folds are closed like the bars of one of your fans, and these closed folds are then doubled twice—once at the small, and once at the large hinge. In order to enable me to tuck them under my wing covers, I make use of the forceps at the end of my body—those instruments which I think you always regard with such horror or even terror.' (Saying this she bent her tail over her back, and seizing the wings by the forceps she tucked them away under her elytra.)

Then she continued: 'Whilst speaking of my forceps, I may remark, that those of the females are not so large nor so formidable in appearance as those of the males. Although it is not very probable that you will ever see my wings, you are very likely to see those of a small relation of mine—the Little Earwig (*Labia minor*), as he flies abroad in the afternoon, or about sunset, in hot weather. But I think I have detained you too long, and in taking my leave of you, may I say, with all respect, that among all my fellow-creatures whose life-stories you have heard, I think you have not met with one who has proved herself to be a more "devoted parent" than myself.'

Here the Earwig dropped among the plants, and disappeared from our gaze.

MOLE CRICKET.

VI

An Underground Explorer

The Mole Cricket (*Gryllotalpa vulgaris*)

WHAT has made this ridge, I wonder? Perhaps it was made by a field mouse, or a—— Whilst I was stooping down to examine it, and was thinking what to suggest, I perceived a slight motion, and at the same time I saw a dark-brownish insect, which I at once recognised as a mole cricket. 'Oh!' I said, aloud, 'if I could only persuade him to tell me something about himself!' He must have heard my remark, for he quietly replied, 'Well, if the work and life of an underground miner are of any interest to you, you are welcome to a short account of mine.'

I thanked him, and he then addressed me:

'My name is *Gryllotalpa vulgaris*, in learned society, but perhaps you may know me better as the Mole Cricket. Either name is very appropriate, as I combine the peculiarity of my near relation, the cricket, with that of another fellow-creature, the mole, which you will see as I proceed. I am not altogether a favourite with your friends the gardeners and others, as they complain that my life underground, and my explorations there, which are made in the interests of my family, prove very destructive to some of their favourite plants; and they also point to certain large yellow spots, where the

grass has been destroyed, as proofs of my destructive habits. I must admit that there is some truth in this; but in justice to myself, I must tell you that whatever harm I do is not owing to any mischievous propensity on my part, but simply arises from the necessity of cutting through the roots in the formation of my burrow; and I am glad to state, on the other hand, that there are those who regard me more favourably, considering that I act beneficially, in consequence of my destroying and feeding upon worms and various other creatures.

'Personally I am known but to few, and those only who seek my special acquaintance, being nocturnal in my habits, only coming abroad and making long excursions when you are asleep. I have been wonderfully supplied with all that is necessary for my underground life. As you look at me, you can see that my body and limbs are very strong. The muscles which move my forelimbs are remarkable for their size, and fill nearly the whole of the interior of my chest. My breast is formed of a thick, hard, horny kind of substance, and is still further strengthened within by a double framework of gristle, in front of the ends of which my shoulder-blades are firmly jointed. My forelegs, or arms, are broad, and my hand, you see, has four large, sharp claws, pointing outwards and rather sideways, which enable me to throw out the earth on each side of my burrow. My other four feet are very strong, and there is not a part of me that is not designed for my special work. If you were to try to imprison me in your hand, you would soon get some idea of my strength. So great is it, indeed, that we can overcome any obstacle of the kind that we most usually meet, although it may amount to moving a load of earth equal in weight to six pounds upon a smooth level.

'My wife also is very strong, and takes an active

part in the burrowing and excavating work: this is done in order to provide for the welfare of our family. A little below the surface she makes a pretty chamber, in which to place her eggs. Sometimes this chamber is about the size and shape of a hen's egg, and all the walls are neatly smoothed and polished; sometimes it is five or six inches underground, and has a curved neck, which communicates with the surface, and inside all is beautifully smooth. This is made about June, and in it are deposited 300 or 400 eggs, of the size and form of what you call "caraway comfits," and of a dull tarnished white colour. But, with all the care my wife takes for their preservation, they are not always safe, as a fierce neighbour sometimes tries to carry them off. She, however, looks sharply after him, and watching him, she pounces on him, and puts an end to his visits for the future. The burrow in which the eggs are placed is not wide enough to admit of turning round in it, in case we want to make a sudden escape from it; so that to do this, we have been endowed with the power of moving backwards as readily as forwards. To let us know of danger from behind, we are provided with two appendages at the end of our body, which have been called "caudal antennæ," as they bear a strong resemblance to similar organs on the head. I am sorry to say that the fatigue and anxiety consequent upon her family work caused the death of my wife a few weeks after she had deposited her eggs.

'In about a month—that is to say, in July or August—the young ones appeared, and, on leaving their eggs, immediately began to provide for themselves, feeding at that time upon the tender roots of the surrounding plants, whether corn, grass, or vegetables. For the first few hours after being hatched they were white, and resembled their parents, except in not having wings, and

were not more than one-eighth of an inch in length; but by the end of a month they had grown so rapidly as to require a larger skin; and after this they all dispersed, and soon became a darker colour. Our family history is different from all you have hitherto heard (with the exception of the Earwigs) in this respect, that we are active all through life, and do not undergo any changes, but resemble our parents from the time we are hatched. Between the birth and the commencement of winter, the young change their skin three times, and at the latter period are about one and a half inches long. During the winter they keep quiet, going deeper and deeper into the earth, according to the coldness of the weather, and make their fourth change of skin.

'It is about May when the winter quarters are left, and then the future wings, four in number, begin to appear. These differ very much from mine, as you see them now, in several ways: that is, the hinder wings are always open, instead of being folded together. On changing their skin for the fifth time, they attain their full growth (about one and a half inches in length), and at the same time their wings become fully developed; but even then, as you notice, they are very small in proportion to the size of the body, so that we fly, as it were, in a succession of dips.'

(He here opened his wings, and showed us that the front pair were not above one quarter the size of the hinder pair, and were of an oval form, and convex externally, and overlapped at their tips. We also saw that they were not hard and horny-looking, but more resembled parchment. The hinder pair were very large, measuring fully three inches from the outer extremity of one to that of the other; but when closed they were scarcely one-twelfth of an inch in breadth, and looked as if they were a tail of the front pair, from under which

they came. We could see he belonged to the order Orthoptera.)

He then continued: 'Some people have doubted whether we can chirp or make a noise, like our cousin the cricket. Certainly we can, as I said at first, and that is why we are partly named after him; and it is also the reason why, in one village in England, where there is a large colony of my family, they are called "croakers," because the sound is not very unlike that of a frog—not very complimentary to us!—but I may, perhaps, be allowed to add, that our note is softer and more musical than his. It can be heard at a distance of some yards; but when a number of us join in a chorus, we may be heard one hundred yards off! It is the way we call our wives out of their burrows. I may, in conclusion, say that the sound is produced by rubbing together the edges of our front wings, which causes a dull, low, jarring note. This we can keep up for a long time without interruption.

'As to my age at the present time I cannot speak with positive certainty, but I believe I am a little over three years old, which is creditable, considering the numerous enemies that I have in human beings, and also among my fellow creatures, including my own immediate relations. I regret to say that our own mothers are our worst enemies; if it be true, as has been stated by Mr. Carter (one of our biographers), that they destroy "nine-tenths of their offspring." But here I must stop. If my relations have in any way been injurious to your plants and vegetables, I hope you will still think kindly of me, and remember that my mode of life and habits, as well as the wonderful structure and strength of my limbs, were designed by the Creator for the special sphere that He intended me to occupy.'

VII

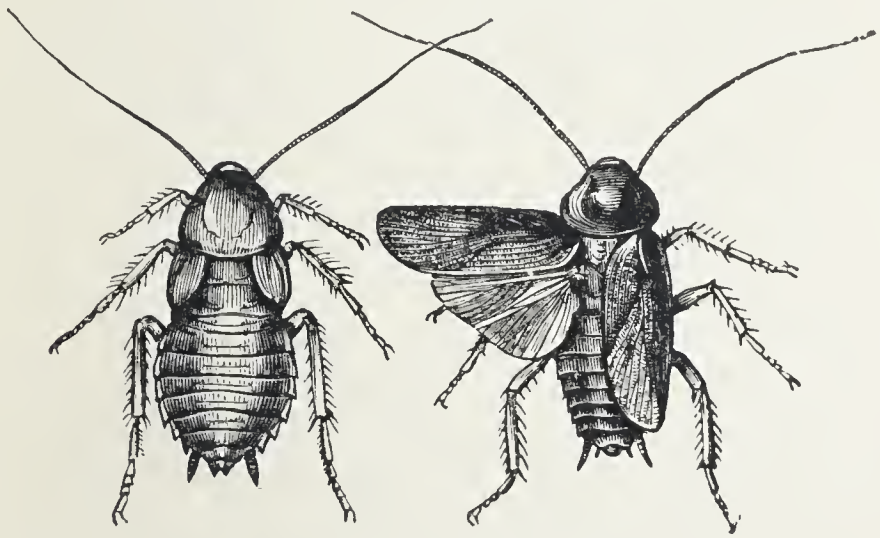
'High life below stairs'

The Cockroach (*Periplaneta orientalis*)

THE insect whose autobiography will now be given is well-known among us as the domestic cockroach. Its claim to that title being derived from its taking up its residence in our homes, and there being so frequently seen. Many persons will probably regret that it is not 'more conspicuous by its absence.' Being thus common, we shall not have any difficulty in procuring one. The kitchen has been in darkness some time, so we will take a candle, and walk in quietly. We no sooner enter than we hear a scuttling noise, and see them running about with great quickness in all directions; but before all have disappeared we have succeeded in capturing one, a full-grown male, and we will now ask him to tell us something about himself, and in so doing we hope that he will be able to remove a little of the prejudice which many of us have against him. He replies:—

'I belong to the same order (Orthoptera) as the last speaker. I am perfectly aware of the unfavourable opinion which you all have concerning me, and I am afraid there is not one among you who will be willing to say a good word in my favour, or to look upon me with the smallest affection; but, at the same time, I do not want you to show your affection for me in a manner similar to that mentioned by the late Rev. J. G. Wood.

He tells us that some years ago, two young ladies, sisters, were at a school in London, where they had been sent from Jamaica, their native place. After every one but themselves had gone to sleep, they used to get up quietly, slip down into the kitchen and catch some of my relations, *not*, I am sorry to say, with the laudable intention of studying their habits, or to keep them as pets—but to *eat* them! I shudder as I tell you the story.



MALE AND FEMALE COCKROACHES.

'But I pass on to more genial subjects. I am not "a true born Briton," but am one of Her Majesty's naturalized subjects. India is my native country, but it is very probable that my ancestors were brought here from the Levant. This was between 300 and 400 years ago; at all events, an old historian of my family, a Mr. Moufet, writing in 1634, speaks of us as having been found in wine cellars and flour mills, so that we must then have been here some time. Why I am called a cockroach I must leave to others more learned than myself to decide; but I am often amused at being called a "black-beetle," which is as wrong as it can well be! As you see, I am not black, but reddish brown; neither am

I a beetle. There is a considerable difference in the structure of our wings, which causes us to be placed in two different orders, the Coleoptera and Orthoptera, the former having the front pair horny and leathery, and meeting down the back in a straight line; whilst in the latter order, to which I belong, the pair resemble parchment, and they overlap at their tips. I may just say here, that it is only we males who have wings, the females being entirely wingless. You will thus understand that although we are now universally met with all over England, both in town and country (much more plentifully in the former, however), our distribution has been brought about entirely by human means. The laundress has been of very great assistance to us, whilst railway companies have carried us to all parts of the country free of expense, and with very little inconvenience to ourselves.

'Commencing with my earliest days, the first thing I have to speak about is the egg from which I came. Sixteen eggs, containing my brothers and sisters, were laid by my mother in a large horny capsule of very remarkable construction. It was oval and had rounded ends, and a long toothed ridge upon its upper edge. The scientific name of the capsule is *ootheca*, which means "egg-purse," and was carried by our mother at the end of her body. If you look about you will probably notice some of them, and will then be able to see how appropriate the term "purse" is, as it so much resembles one of your steel ones. Some have compared it to that peculiar kind of tart known as a "turnover." Each egg was passed one by one into this purse, until there were eight on each side of it, and it extended outwards further and further as it was gradually filled, its length being increased by fresh additions to its inner end. When all the sixteen eggs were arranged in it, it protruded nearly

half an inch, and was about one quarter of an inch wide. The construction of this purse and the laying of the eggs occupied about a week. My mother carried this egg case about with her for seven or eight days, and then she dropped it into a warm and sheltered crevice, and troubled herself no more about it.

'In course of time we were hatched, and all made our escape out of the case through the toothed slit. After we were all out it closed again by its own elasticity, and looked just as it did before. Some of these empty cases may be found lying about, and an examination of one would enable you to understand its construction. You will notice on the outside eight small rounded projections, set in the row just beneath the opening. Now open it, and you will find a double row of eight cells, each of which is lined with a stout yellowish membrane, the end of each corresponding with the little projection on the outside.

'When first hatched we were quite white, with black eyes, but we soon became darker, and very much resembled our parents, and could run about and look after our food. Almost immediately after our escape from the egg case we changed our skin; again, four weeks later; and a third time, at the end of the first year; and afterwards once yearly at the end of our second, third and fourth years—that is, six times during the four years. Now, unlike the beetles, we do not, when full grown, leave off eating, and become quiet and motionless as pupæ. We have no resting-stage at all.

'My wings gradually developed and grew more and more conspicuous, until at my seventh moulting, *i.e.* just as I was five years old, I became as you now see me. You will at once notice that I differ in appearance from my sisters in several respects. In the first place, as I have already said, they have no wings; and the

wing cases are quite rudimentary. These are large in my case, and underneath them are my wings, folded lengthwise. My antennæ are rather longer than my body, whilst those of my sisters are shorter; and thirdly, should you see me standing by the side of one of my sisters you will notice that I stand rather higher on my legs. We are all extremely active, and run with great rapidity—we hardly ever walk—and it is in consequence of this that we are called "Cursoria" or runners. It is well for us that we can thus run, as it enables us to escape from our enemies. My strength also is very great, and it has been calculated that in proportion to my size I am six times stronger than a horse.

'Our habits are strictly nocturnal. In the day-time we are never to be seen—that is to say, voluntarily! We frequent the kitchen more particularly for two reasons: one being our great fondness for warmth, and the other, that it is here we find abundance of food. Nothing comes amiss to us; our diet is much the same as yours, though our tastes are more varied, and hence it is that we are very partial to old clothes, shoes, newspapers, etc., etc., whilst our beverages are chiefly milk, oil, ink, and blacking! Our digestion is very good—when I said just now that nothing came amiss to us, I perhaps ought to have excepted cucumber, which sadly disagrees with us!

'Our family is a very large one, I believe that I have at least 800 distinct relations in various parts of the world. We are also very ancient, but it is quite impossible for me to tell you how many generations have preceded me, and how many years back they can be traced. All I can tell you is that we were in existence, and formed half the number of insects living at the time when the primeval forests which now supply you with coal were flourishing in all their wondrous splendour

and luxuriance. So abundant were my ancestors at that time, that the period of which I am speaking has been called the "age of cockroaches"; but we existed long before that, and indications of us are said to have been actually met with in the strata of the Silurian age. Our early ancestors differed somewhat from us, as from the remains found of some of them, it would appear that they had *four clear* and *transparent* wings, instead of two, such as we now possess.'

Here he paused, and before we had time to thank him for the information he had given us, *Periplaneta* was rushing away with a speed somewhat approaching that of an express train!

VIII

Life in a Potato Plantation

The Death's-Head Moth (*Acherontia atropos*)

THE next insect whose reminiscences we now hope to give is the largest of its order which inhabits this country. It is probably known but to few in its perfect condition when living, and all that we personally have seen have undergone their various stages in captivity. Several were reared from their earliest stage, others were exhumed, that is, dug out of the ground during the time they were in their pupa state. This latter was the condition in which we found one under the soil last September. In due course she passed into her perfect state, and as she is now before us we will ask her to give some account of herself. To this she readily assents. So now let us listen with all the attention due to this magnificent representative of her order She thus begins :

'I have great pleasure in acceding to your request to give you a short account of my life, as doing this will enable me to remove certain superstitious opinions which appear to prevail respecting myself. I have been regarded as a messenger of "pestilence and woe," while others have looked upon me as the shape assumed by a witch ! I have indeed heard of a whole congregation, on coming out of church, being thrown into a state of

great alarm and consternation by seeing one of my unfortunate relations quietly walking across the churchyard path, and it was only when the heavily-nailed boot of the village blacksmith had crushed his life out, that peace and confidence were restored to the affrighted and ignorant spectators. Now this deplorable ignorance

THE DEATH'S-HEAD MOTH.

is connected with certain marks upon my back, which are supposed to resemble a skull. But granting that they *do* bear some resemblance to this ghastly object, it is yet difficult to understand why this need give rise to any feelings of horror. In some countries the appearance of my relations in large numbers is looked upon with dread; and in the Mauritius we are accused of throwing off a dust from our wings which is absurdly

said to produce blindness in those persons into whose eyes it falls!

'My life commences in the egg. Numbers of these are deposited on various plants, such as the deadly nightshade, the snowberry, the jessamine, and the potato, the last-named plant being most frequently selected by my family. It was in a potato plantation that I commenced my life, and it was there that I had lived previously to my removal. The eggs containing us were deposited early in summer, and we escaped from them as larvæ a few weeks after. At that period of our life, as also now, we were strictly nocturnal in our habits, and consequently are probably unknown to most of you. During the day we rested among the leaves or at the roots of the potato plant, not coming out to work, that is, to get our food, until the night. We grew rapidly and attained our full size in about two months, when we were as much as five inches (and some of us even more) in length, and stout in proportion. I may perhaps be pardoned if I say that we were then very handsome—our general colour varying through different shades of green, grey, and yellow, but occasionally a dark variety appears among us. The whole surface of our body was covered with very small black dots, and on each side were seven diagonal blue or purple stripes, edged with white. Near the end of our tail was a horn, which curved downwards, and then slightly upwards at the tip. Our head was horny, and furnished with strong jaws. We were also provided with six claw-like feet in front, for walking, and eight fleshy ones behind, with two at the end of the tail; all these ten legs being used as support to the body, or as enabling us to clasp a leaf or twig. On each side of our body you could have seen nine openings, by which the air was admitted for the purpose of respiration.

'At this stage of our existence we are liable to the attacks of a large ichneumon fly, *Trogus atropos* (Wood), which we are quite unable to resist. This creature never tires of searching for us, and, notwithstanding our retreat among the leaves and roots of the potato, always succeeds in finding us. Having done this, it makes a sudden attack upon us, at the same time depositing

LARVA OF THE DEATH'S-HEAD MOTH.

some of its eggs in our bodies by means of a very formidable instrument with which it is provided. In due course the grubs come out, and commence feeding upon us, and so reduce our strength as finally to cause the death of any one so attacked. Should we escape its attack, we are full grown about July, and begin to make preparation for our next change. To do this we bury

ourselves eight or ten inches deep in the earth, and there, by the means of our head and body, and of a peculiar fluid with which we are provided, we form a smooth oval cell; and here we quietly rest enclosed in the horny shell in which our wings and other parts are being prepared. This is our pupa state, in which we remain until September or October, when we arrive at our perfect or imago condition, as it is called.

'On first coming out, our wings, legs, and antennæ, or feelers, are wrapped up in a fine, delicate membrane, which soon falls off when exposed to the air, and so allows us to stretch our limbs. We are now the largest representatives of our family living in this country. Our wings, which cause us to be placed in the order Lepidoptera, when fully spread are five inches across from tip to tip. You will also notice how remarkably I am covered with long hairs. My wings also have a soft downy appearance, arising from the structure of the scales. If you detach one and look at it under a microscope, you will see that it is large, and increases in width from the base to the tip, where it divides into four or five long points.

'Before I take my leave of you, I must express my regret that some of my family have a propensity which is not strictly correct, and which causes them to be much disliked by my industrious neighbours, the bees. I allude to their forcing their way into the beehives and robbing them of their honey. I am happy to say that this habit is but little practised by my relations in this country. Some of your learned men have suggested that, while robbing the hive, the bees are kept quiet by the peculiar noise which we have the power of making. The way in which the noise is produced has been, and still is, an undecided point among you; but in accounting for it I must remind you that I am able to make it in

my first, or larval, stage as well as in my present one. Another remarkable feature of it is, that of my family being the only one capable of making it.

'But I must now leave you. My time is short, and before the autumn comes to an end I hope to provide for my future family by depositing my eggs in some safe place, where they will remain snugly through the cold of winter, and be ready to burst out into active life early next summer.'

IX

'Four Years in the Wood'

The Goat Moth (*Cossus ligniperda*)

WE have received the following letter, signed 'A Goat Moth,' which will be interesting to our readers, as giving them a history of another life, passed under very different conditions to any yet mentioned. The writer calls it 'Four Years in the Wood,' and his reason in forwarding it will be seen from his opening lines. 'As one of the same order (Lepidoptera), it was with great pleasure that I read the very interesting sketch of the life of my cousin, "Death's-Head Moth." So interested indeed was I, that though my life has been spent in retirement, and away from "the busy haunts of men," I determined to send you a brief account of it, as showing the manner in which I have passed my days up to the present time in surroundings so very different. I am now getting old, and have long passed the time allotted to most of my relations. Four years of that time I have passed in the depths of the wood, and never since the days of my earliest recollection have I known the tender solicitude of an anxious mother, nor have I felt the caresses of an affectionate father; but I was early left entirely to myself.

'It is just over four years since my mother deposited me as a helpless egg in a small crevice in the bark of a

willow-tree. It was about the size of a rape-seed, nearly round, but slightly elongated at the upper end, and of a dull pale brown colour. Between ten and fifteen days after (I cannot fix the exact date), I appeared as a slender grub, a larva, partially and thinly covered with hair. Within ten hours of my birth I began to show a strong inclination for exploring the wood, and being endowed by Nature with a good constitution and iron muscles, I succeeded in making my way in a manner very surprising to many of my friends. My first entry into the wood was made by piercing a little hole or tube in the bark, not thicker than the slenderest wire—so fine, indeed, as to be quite invisible, save for the small heap of sawdust at the entrance. I got further and further into the wood, making my burrow larger and larger as I grew rapidly on the starchy food from the wood. I know that my explorations are not looked upon with favour by man, seeing that it is by these means some of his noblest trees are from time to time destroyed. They become so weakened by the galleries we make in all directions, that they are blown over by the first strong gale. Among the trees of which I am specially fond, beside the willow, I may mention the elm, oak, birch, and alder.

'Here I may as well tell you what I was like at this period of my life, that is, as a larva. I think it not unlikely that I might have been considered a curious-looking creature then. My skin was very smooth and shining, and was without hairs, except some stiff bristles, which projected from each division of my body. My colour was a pale mahogany, and I had a large oval patch of a similar colour on the back of each segment. My head, and a plate on the second segment, were black. My body was rather flattened, and my head was wedge-shaped, and furnished with very powerful

jaws. For strength was just what I needed, and certainly when full-grown I was enormously strong. It is owing to this, and I may also add, to our perseverance under apparently the most insurmountable difficulties, that many attempts to detain us in captivity have signally failed. Our family records contain two very remarkable instances. One of my ancestors was once shut up under a large glass dome, half a pound in weight, and in order to prevent his escape, a book weighing four pounds was placed on the summit; but having succeeded by his strength in just getting his head under the foundation of the dome he was able to make his escape. Since the days of Samson I doubt whether a more astonishing exhibition of strength has been recorded. The second instance is a remarkable display of intelligence. This Goat Moth larva was confined in a deep dungeon or well made of glass, many times deeper than his height, so that escape seemed impossible; but, no! the ingenuity of my ancestor overcame it. He managed it thus: by means of a strong silken thread, with which we are naturally provided, he spun a succession of steps from the bottom to the top of the glass well, and ascending them, as he continued his labour, he in due course reached the top, and so escaped!

'In quite recent times some of my relations, even though shut up in cells with perforated zinc sides, have effected their escape. This is, as I have said, due to the great strength of our muscles. A celebrated naturalist and anatomist, Professor Lyonnet, so long ago as 1762, made a most perfect examination of our bodies, and from his wonderful book on the subject, I find that on the two sides only, omitting those of the head and other parts, there are no less than 1,647 muscles. In my head I believe 228 muscles are found. And in the

whole of my body as many as 4,041 ! whilst your bodies contain only 529, or perhaps less !

'But to return to my history. For three years I carried on my exploration, daily penetrating further into the heart of the wood, and meeting with but few incidents to vary the monotony of my life. The sun which shone so brightly, and gladdened all Nature by its bright beams and genial warmth, was totally hidden from me by the denseness of my forest home ; but I had the satisfaction of knowing that my labours here were coming to an end. I had now attained my full growth, and was about three and half inches in length, and notwithstanding all I had gone through, I was about two inches round my waist. It was now May, and I began to think about making a change, and my first business was to see whether there was a clear road in front of me when I wanted to leave my home in the wood. This was most important, because if there was not one, I must make one now, because at the time of my leaving I should not possess the strong jaws and muscles that I then had. This being done, I commenced making a cocoon from very small bits of wood, or sawdust, united together with silk. It was in the form of an oval cell, and was lined with grey silk, the end pointing towards the hole by which I should leave the wood being thinner than the other end. I was also careful to place myself inside it in the direction in which I should have to leave.

'Well, here I rested some days very snugly, and perfectly secure against the attacks of any enemies. Change now began to take place in me. My body lost its red colour, and became pale, pitted all over with brown spots ; these increased in size until at length my whole body was a dark brown. Meanwhile, changes were also going on elsewhere, in my head, legs, and so forth ;

presently the skin split, and I appeared in a form altogether new. I was now in my pupa condition. At first I was white and soft, but soon became hard and brown, and enclosed as it were in a coat of mail. Notwithstanding that I had no legs, I was still capable of moving, each segment of my body being furnished with two transverse rows of teeth, pointing backwards. These were destined to be of immense service to me presently.

'Towards the end of June the time for my leaving the wood drew near. By means of a peculiar fluid which I possessed as a larva I had just before my change softened the silk in front of my head, and I was now able to force my way through it. My teeth, as I have just said, were all arranged backwards, and so by alternately contracting and stretching myself, they pressed against the sides of my burrow, and as they would not let me go backwards I was thus pushed forwards. So I proceeded until at length I reached the opening (or thin place in the bark). My head and shoulders protruded—the parts of my pupa case separated, my legs were set free, and I was able to crawl out altogether a few inches up the bark. My wings were yet crumpled and hanging down, and so there I remained until the sun and the air had strengthened me, and I could fly away, never more to enter that wood in whose dark interior I had passed the last four years of my life. I hope to spend what few days, or rather, I should say, the few nights, that remain to me in paying flying visits to my relations, and in settling my children in those situations that will best conduce to their success in life.

'Yours ever,

'A Goat Moth.'

And so ends his letter.

X

The Mask, and its Wearer

The Dragon-Fly (*Æshna grandis*)

NOT long since we were spending a few days in the country, and whilst there we endeavoured to make ourselves acquainted with the interesting creatures that we saw swimming about in the ponds of the neighbourhood. Provided with a net, pickle bottles (free from all odour of their former contents), and other appliances necessary for the capture of aquatic insects, we started out to explore some of the aforesaid ponds. Fortune favoured us, as was soon manifested by the rather too-crowded condition of our bottles. Whilst sitting awhile after our labours by the side of a pond, whose surface was covered by the floating leaves and pretty flowers of the water crowfoot, or, as botanists term it, *Ranunculus aquatilis*, we suddenly caught sight of a grub, or more strictly speaking, of a middle-aged insect, by which we mean a pupa. Knowing that his family were remarkable for a peculiar mask-like organ of wonderful structure, we were desirous of hearing something about it, so we determined to avail ourselves of the present opportunity, and to try and persuade him to give us a short sketch of his life. To this he readily assented, and began as follows :—

'In compliance with your request, I have great plea-

sure in presenting myself before you from the summit of this wide-spreading plant for a few minutes, in order to give you an account of my life up to the present time. You are perhaps not aware that, in the state in which I now am, the air necessary for my respiration is not inhaled, as in your case, but more in the manner adopted by fishes. At the end of my body is an apparatus consisting of five horny plates, of unequal size, three being much larger than the other two. These plates I have the power of opening and shutting at pleasure. On opening them a valve, which had previously been closed by three small membranous plates, is opened. A quantity of water then rushes in ; the air which is mixed up in it is extracted by means of certain gill-like organs situated in the interior of my body, through which it is conveyed by tubes, and so my respiration and circulation are carried on. Having extracted the air, I eject the water, and take in a fresh supply. Neither myself nor any of the class to which I belong breathe air through our mouth or nose, as you do. If therefore you will kindly allow me to expose only my head and shoulders whilst the lower part of my body is beneath the water, I shall be able to address you with comfort.

'My parents, I am told—for I never saw them that I am aware of—belonged to a class called by some people Articulata. This has reference to the joints of our bodies, and not, as perhaps might be imagined, to our powers of speech or articulation, for I can safely say that we talk very little, this faculty being of little use to us, as we are generally so fully occupied in getting our daily food that we have not time for much conversation with each other, and I regret to add that the fact of our living on the same kind of food causes us not to act in the most friendly manner towards each other. The class to which I belong has several classes and

DRAGON-FLY.

orders, and I feel a certain amount of pride at the position which my family holds in one of them. The class is called Insecta, and the order Neuroptera.'

(He here apologised for using such hard words, but informed us that there is no term in our language that would so well express the same; it was derived from two Greek words, signifying 'nerve-winged.')

'My family,' he continued, 'is a very ancient one, and some remains of my ancestors have been found who must have lived many, many thousands of years or ages before the land upon which you tread was prepared for your habitation. These remains were found at a place called Solenhofen, in Bavaria, in a peculiar kind of limestone. At the time of his death my ancestor was in his "perfect" condition (or imago state), and both pairs of wings remain, and even the markings on them are admirably preserved to this day. Other remains have been found in these islands, and it appears that in the far-distant periods of time some of my family then living were giants compared with the largest of any now living.

'But to return to my birth. The eggs which contained me had been deposited by our mother on the surface of the water, and the first thing I can remember was finding myself, in company with my brothers and sisters, creeping amongst the branches of these very plants in search of food. This is now nearly a year since. Our home being well stocked with every luxury, you will not be surprised to hear that we grew very rapidly. The first few months of my life were passed in a slightly different form to that in which you now see me. I was then called a larva, and had not these wing cases on my shoulders, which form the distinguishing feature of my pupa, or second state. I expect very shortly to leave the home of my ancestors for a third and more

perfect state (imago). But you will perhaps like to hear something of my daily life.

'I awake early in the morning, and at once look out for my breakfast. I am carnivorous in my tastes, and though I am not particular, I must say I prefer a young tadpole to any other dish. I am exceedingly expert at capturing these animals, and am provided with an apparatus which is the exclusive property of our family. It is sometimes called a "mask," but in reality it is my under lip, which I keep so neatly folded up when not in use, that if you had not some previous knowledge of it, you might very likely overlook it. It has justly been called "one of the most remarkable prehensile instruments in which the art and skill of a Divine Mechanician are singularly conspicuous." The best description of it in your language is that of Messrs. Kirby and Spence. They say: "Conceive your under lip to be horny instead of fleshy, and to be elongated perpendicularly downward, so as to wrap over your chin and extend to its bottom, that this elongation is there expanded into a triangular convex plate, attached to it by a joint, so as to lead upwards again, and fold over the face as far as the nose, concealing not only the chin and the first-mentioned elongation, but the mouth and part of the cheeks; conceive moreover that to the ends of this last-mentioned plate are fixed other convex ones, so broad as to cover the whole nose and temples; that these can open at pleasure like a pair of jaws, so as to expose the nose and mouth, and that their inner edges where they meet are cut into numerous sharp teeth or spines, armed with one or more long and sharp claws." If you can imagine all this, you will have a good idea of my under lip. When required, this apparatus can be opened and projected forwards, and I am thus enabled to seize my prey.' (Just at this moment a young tad-

pole swam by within a short distance of his head, the 'mask' was suddenly extended, quicker than our eyes could follow, and then we saw that the tadpole had been captured.) Having partaken of this refreshment, he proceeded :

'You thus see that I have no great difficulty in obtaining my food. Although I commenced with breakfast, I should state that I do not take my meals at certain times, as you do ; for not only do I "eat to live," but at this stage of my life my meals are really my only occupation, so that I may be said "to live to eat."

'Although provided with three good pairs of legs, I do not use them very much, except just for crawling about in the lower part of my residence. If I am in a hurry and want to get quicker through the water, I make use of the apparatus at the end of my body (which I have already described), by taking in an amount of water and then suddenly expelling it. I am propelled forwards with great rapidity, and some of your engineers have actually attempted to imitate this instrument and to apply it to practical purposes.

'In two or three weeks I expect to leave my present abode. The way in which I shall accomplish my third and last change is as follows. By means of the claws at the end of my feet I shall fix myself securely to the stem of one of the plants in this pond which raises itself a few inches above the surface of the water. In this position the whole outer covering of my body will become dry and brittle, until upon my using a little exertion it will crack down my back, the slit becoming gradually larger, until of a sufficient size to allow of my head and legs being withdrawn. I shall remain in this position for a short time, keeping my head backwards ; I shall then seize hold of the stem of the plant with my forelegs, and shall draw out of the case the remainder of

my body. My wings, which are still folded up under these covers which you see on my back, will then gradually expand, and at the end of about two hours will be fit for use. I shall have four large wings which, thin though they appear, are formed of two layers, each layer consisting of an upper and lower surface, between which are several parts necessary for preserving their shape and carrying out the work they have to perform. The small fine lines on them are really tubes, which spread out in great numbers between the two parts, and so add to the strength and durability of the wings. From their size and strength our family have always been remarkable for the swiftness of their flight, and such is their power and so great the force of the muscles which move them, that weariness in flying is a thing unknown to us. A celebrated naturalist, M. Leeuwenhoek, once watched one of my ancestors whilst he was being pursued by a swallow. Swiftly though this bird can fly, it was unable to overtake my relation, who succeeded in keeping about six feet in front of him. As another proof of the power of our wings, I may tell you that one of my relations once flew on board a ship, the nearest land being 500 miles distant.

'My eyes, which even now are large and bright, will in my perfect state be still larger and brighter. We have no less than five eyes. Of these, the large one on each side of our head is called "a compound eye." I shall not say more about this, as you will hear more about it in "The Tale from a Tub" by *Culex pipiens*. The other three eyes are simple, and more like your own; you will find them on my forehead.

'Before taking my leave of you, I may just say that my breathing in my perfect state will be carried on, as you have already heard, by openings (or spiracles) on the sides of my body. The time for me to enter upon

my perfect state is rapidly approaching, and as I shall then be flying about all day, it is very likely that we shall meet again, when I shall be proud to show you what I can do with my wings. Some uneducated people frequently call us "horse-stingers." This is altogether wrong, for even supposing that we had the desire, we do not in the least possess the power of hurting or stinging others. The only offensive weapons we have are strong jaws, and these are used entirely and solely in obtaining our food. I hope therefore you will not be alarmed if I approach near you, as I am quite as harmless as that butterfly hovering over you. You will have no difficulty in recognising me—my size alone will help you to distinguish me. My wings measure nearly four inches from tip to tip across my back, and my body, which is very long and slender, is about three inches in length from the front of my head to the end of my tail.' Saying this he slipped off the crowfoot upon which he had been resting, and was soon lost to our sight in the depths of his aqueous home.

XI

A Home Under Water

Caddis Worm (*Phryganea grandis*)

'A HOME under water' does not sound very pleasant, nor does it appear a very suitable locality for a comfortable home. It surely must be very damp. You do not think that *you* would choose such a situation! But we are not all formed alike, and then the 'homes' of which you are about to hear are found to be wonderfully adapted to the wants of those who reside in them. These 'homes' are much more common than most people are aware, and it will not be a difficult piece of work to find one. They are to be looked for in ponds and streams, and possibly in the first of either that we come to we shall meet with some of them. They are all one-storied homes, but in outward appearance, or architectural design, they differ considerably. Here we are at the pond, and as we stand upon the edge and look into the shallow part near the bank, we see some mysterious-looking objects moving about at the bottom. These are the homes to which we refer, and each one is occupied by one inhabitant. We will capture one of them, and persuade him to tell us his history. This we have done, and we will now let him speak for himself.

'In the language of Science my name is *Phryganea grandis*, and, unlike your name, my surname comes first. I am perhaps better known to you by one of these

names—Cadis, Caddis Worm, Straw Worm, Piper, Cockspur, Sand-fly, Grannuns, or Cinnamon Fly. I must leave it to you to trace out the origin of my various aliases or nicknames. The condition in which you see me now is that of a larva. My family occupies a place in the order Trichoptera, but that is a rank which I do not really attain until arriving at my final or perfect state, and this because until then I do not possess the wings from which the name of the order is derived. As a larva I am now living at the bottom of this pond in my own house, and that too is one of my own building. I have many enemies around me, and in the summer many of my relations fall victims to the attacks of numerous fishes. Before describing my home, I will tell you something about my life.

'We begin life in an egg. The eggs which contain us are small and greenish, and previously to being deposited are carried about by our mother in two little bundles attached to her body. Each bundle is formed of a gelatinous substance which has the power of resisting water. After a time she entered the water, not merely walking on it, like many other aquatic insects, but also swimming in it with great rapidity. She then selected a suitable plant, and crawling down its stem several inches below the surface, she there attached her precious bundle. Having done this, she left her eggs to be hatched in due time.

'In my present state I have a long, soft body, my head and neck only being of a horny nature. Being thus, as you see, somewhat helpless against the attacks of my enemies, it becomes necessary for me to take means for protecting myself, and hence it is that I at once commenced building a house. If you look about you will notice that our houses do not resemble yours—that is, they differ in the material of which they are

CADDIS WORMS AND FLIES.

built, and also in their shape. There is yet another difference, and that is, that whilst your houses are designed by various architects, ours were all designed by the Creator—the one Great Architect. Our habitations are constructed of various materials, and no matter what their external form may be, they are all cylindrical and smooth in the interior. Some of my relations (*P. rhombica*) form their house of two leaves, fitted together face to face. Another takes short pieces of grass stems, cut into nearly equal lengths, and then fixed across each other, leaving a hollow in the centre. The pieces are sometimes made longer, and are laid side by side. One of us (*P. fusca*) makes use of the shells of various small living aquatic molluscs. These are all fastened together, and are dragged about, whether agreeable to them or not. Another relation (*Sericostoma multiguttatum*) constructs his house of particles of sand, very small stones, and similar material, and forms them into a conical case, which is slightly curved like a horn. There are many different forms of houses, which I cannot refer to ; but here is one more. It it made of a leaf, or piece of grass twisted round and round, and very much resembling a spill used for lighting a candle. But you will perhaps be thinking that our houses must be a great weight for us to draw about ; but no—each house is built with great care, that it shall not be too light ; for if it were, it would buoy us up, and perhaps bring us up to the surface away from all our food, or else it would require some exertion to keep it down ; whilst if it were too heavy it would tire us to pull it about all day, so we take care to avoid the former by adding a bit of stone or shell ; or if the latter, by fixing to it a little bit of wood or straw, and by these means we make the house so very nearly equal in weight to the water that we can walk about without any inconvenience.

'But now my house is finished. It is round inside, and a little larger than my body, but in order to make it more comfortable it is lined with silk. It being only a little larger than my body, as we grow the house requires enlarging. But before I leave off talking about my house, it would perhaps interest you to hear of some curious experiments that were made some years ago by Miss Smee. This lady was very fond of watching us, and having procured a number of my relations from a small stream, she placed them in separate glasses of water, having first of all turned them out of their homes. This does not seem a very kind thing to do, but it is only fair to say that she supplied them with fresh materials to build other houses.

'It was a strange collection of things that she gave them. Here is a list of them. They had bits of coloured glass—amethyst, cairngorm, carnelion, agate, onyx, coral, marble, shell, and mother-of-pearl.[1] Brass shavings, or gold and silver leaf, puzzled my relations sorely, as they could not make a regular case. One had bits of a tortoiseshell comb, and when his house was finished, it looked like a hedgehog. Slate, coal, brick, and other substances were also given them; but chips of various wood proved fatal to them.

'Although most of us live in movable houses, there are some who prefer a fixed dwelling-place, and therefore attach them firmly to a stone.

'It is time that I should tell you how we live in our homes. In the first place, at the end of our body are claspers by which we can hold ourselves inside very firmly. These claspers are modified in construction according to the kind of habitation. In those that live in fixed habitations they are placed at the end of two

[1] Smee, *My Garden*.

long footstalks, so that though they never entirely leave their house, they can yet stretch themselves out some distance, and so get a wider range for their food.

'Living in a movable house, my claspers are short, as I only need to protrude my head and legs, and drag my house anywhere I desire in search of my food, which I may add consists generally of a vegetable diet, occasionally, however, varied with animal substances.

'Naturally, my home becomes, as I grow, too small to contain me; not only is it short, but it is not sufficiently wide, so every addition which I make to the front end is rather larger in diameter, and this gives my dwelling a slightly conical form; then the smaller or hinder end is cut off, so that by these two operations the house is always the right size.

'But you would perhaps like to know how I am able to breathe in my aqueous home. I will try and answer the question by withdrawing myself some distance out of my dwelling, and will call your attention to the segments of my body. On them you will notice a number of white hairy threads; there are arranged in bundles—four on each segment, two above and two below. Running down the whole length of these threads are several air vessels, which run in a serpentine direction, growing more slender as they approach to the extremity, and in some places sending out very fine branches. These are my breathing organs; the water flows over them, and in so doing parts with the air which is mixed up with it; in fact, I breathe much in the same way as fishes, the hairy threads acting like their gills. I am now nearly full grown, and shall shortly pass into my next or pupa state. Before doing this I shall fasten or moor my home to a large stone by threads. I shall then close both ends by a little grating of silk, of such a wonderful kind that instead of being

dissolved or softened by the action of water, it actually becomes hardened by it. This grating is intended to keep out intruders, though at the same time it admits the water necessary for my respiration to flow through.

'Here I shall remain perfectly quiet and inactive, and in three or four days shall change into my next or pupa state. My appearance then will be much altered, for I shall have a much greater resemblance to my perfect state, except that some of my organs—that is, the antennæ or feelers, wings and legs—will be shorter, and all enclosed in separate sheaths, and arranged upon my breast. Two or three weeks later I shall break through my grating, and having regained my former activity shall rush out of my house with great speed, and by the aid of my legs, still in their sheaths, shall swim rapidly through the water on my back in the search of some dry place, and when in the open air I shall shake off my pupa skin, and shall appear in my perfect form. I shall then have four wings, and on examining them you will be able readily to see the meaning of the name given to the order to which I belong, viz., Trichoptera. This means "*hairy wings*," and if you examine those of my relations who are more advanced than myself, you will see that their two anterior wings are profusely covered with hairs. The hinder pair are larger, and are folded when at rest, and are raised, and meet above the back. I am sorry I cannot describe them as beautiful in all my relations; they are various shades of brown, mixed with more or less yellow. In the larger members of my family the wings when fully expanded are about two inches from tip to tip. I may say in conclusion that we differ very much in our habits. Some of my relations are nocturnal, living in the daytime amongst herbage, or on the trunks of trees. Many are much smaller, and may be seen flitting about over the surface of ponds.'

XII

A Little Nuisance

THRIPS MINUTISSIMA—(no popular name)

MINUTE though this insect is, we shall probably have no difficulty in finding one, for they are very plentiful, and are to be seen in greenhouses and on flowers and plants ; but wherever it is, their presence is anything but desirable. The underside of leaves is their favourite resort, and here we may find them in numbers. Though it is a small insect, its life history may contain something worth listening to, so we will look for one. It is not unlikely that the rose-tree from which we procured the earwig will also supply us with one of the Thrips. Here is one.

'Now then,' said he, 'please handle me very carefully, or your great clumsy fingers will soon crush all the life out of me. You want me to tell you something about myself. Well, you cannot expect much from a little creature like me, only one-twelfth of an inch long. If you can hear what I say, you will certainly find that your eyes are not strong enough to see several interesting points in my structure, so you will find a pocket lens very useful. The only name I have is Thrips, which I believe mean a "wood-worm," but I do not know what that has to do with me, but "what's in a name?" Sometimes

one or two syllables are put in front, and then my relation becomes Phlæothrips.

'The order in which I am placed is called Thysanoptera—it's a long name for such a mite as I am! I will explain its meaning by-and-by. The egg from which I was hatched was cylindric, rounded at one end, and crowned with a knob at the other. As a larva I was active, and lived in the same situations as my parents, from whom I differed in being smaller and

THRIPS.

having a softer body of a paler colour. My antennæ and legs were shorter, and my eyes were different; and of course I had not got my wings. In my next, that is the pupa state, I was nothing like so active as I had been. I resembled my parents. You now see me in my perfect state. My wings, which in my pupa stage were enclosed in short fixed sheaths, are now to be seen. They are four in number, linear, narrow, and not folded, nor looking like network. The membrane is small, but your lens will enable you to see that the margins often are fringed with plume-like hair; and these when I am

flying separate, and so compensate for the smallness of the wings by adding to the surface exposed to the air. These fringes have given the name to my order—Thysanoptera. I have three pairs of short legs, and the last joint of each ends in a bladder-like swelling, without claws. When walking, this bladder presses on the surface of the leaf, or whatever I am walking upon; and its diameter is increased, and becomes concave, more or less, according to the pressure upon it. This inflated bladder has given another name to my order—that of Physopoda. My mouth is composed of parts united together to form a short, conical, and fleshy sucker, not retractile, and is most useful in piercing the delicate parts of plants, and so enabling me to live upon their juices; but whilst this is the case, I am bound to admit that it is very far from being beneficial to the plant. When my sucker is not in use, you will find it lying under my breast. And here I close the short history of my life.'

XIII

A Great Architect

The Common Wasp (*Vespa vulgaris*)

THE insect whose life fills this chapter is one of those whose 'room' is very decidedly to be preferred to his 'company,' and no wonder at it. In the first place, they visit us unceremoniously and uninvited, and in the spring time of the year much too frequently. They make free with everything they can get at. This is what Messrs. Kirby and Spence say about them: 'Sugar, meat, fruit, and wine are equally to their taste! And if we attempt to drive them away, and are not very cautious, they will often make us sensible that they are not to be treated with impunity. Compared with bees, they may be considered as a horde of thieves and brigands; and the latter as peaceful, honest, and industrious subjects, whose persons are attacked and plundered by them.' These are their bad qualities; but, on the other hand, 'With all their love of pillage and other bad propensities; they are not altogether disagreeable and unamiable, they are brisk and lively; they do not usually attack unless provoked; and their object in plundering is not purely selfish, but is principally to provide for

the support of the young brood of their colonies.' So now let us be—

'To their faults a little blind,'

and try to derive some pleasure and instruction from their virtues. Here is one that has just flown into the room, and is now beating herself against the window pane in the endeavour to find her way out again. We will keep at a respectful distance, and listen to what she has to tell us.

'I am perfectly aware of the great dislike—must I say hatred?—that you all have to me and my relations. Why this should be so, it is difficult for me to say Very seldom indeed is it that we interfere with you, and that only in self-defence. Few of you, I know, would care to follow the example of Sir John Lubbock, and keep me as a pet, as he did one of my foreign relations from the Pyrenees, for no less than nine months, until death separated them. I am bound to admit that we help ourselves to your fruits, and, perhaps, cause annoyance to your grocer by our partiality for sweets; but, on the other hand, the butcher may look upon us kindly, as we rid his shop and stalls of the numberless flies who are his greatest enemies during the summer. In fact, in America, the nest of my relation, the hornet, is sometimes suspended in the parlours, on account of its value in destroying flies.

'Sometimes we get hold of a bluebottle too heavy for us to carry, but even then our reason will help us out of the difficulty. In proof of this, I may tell you that Dr. Darwin once saw one of my relations on the gravel walk with a fly nearly as large as himself. It was too heavy for him, so he cut off the fly's head and body, and flew away with the chest (thorax), with

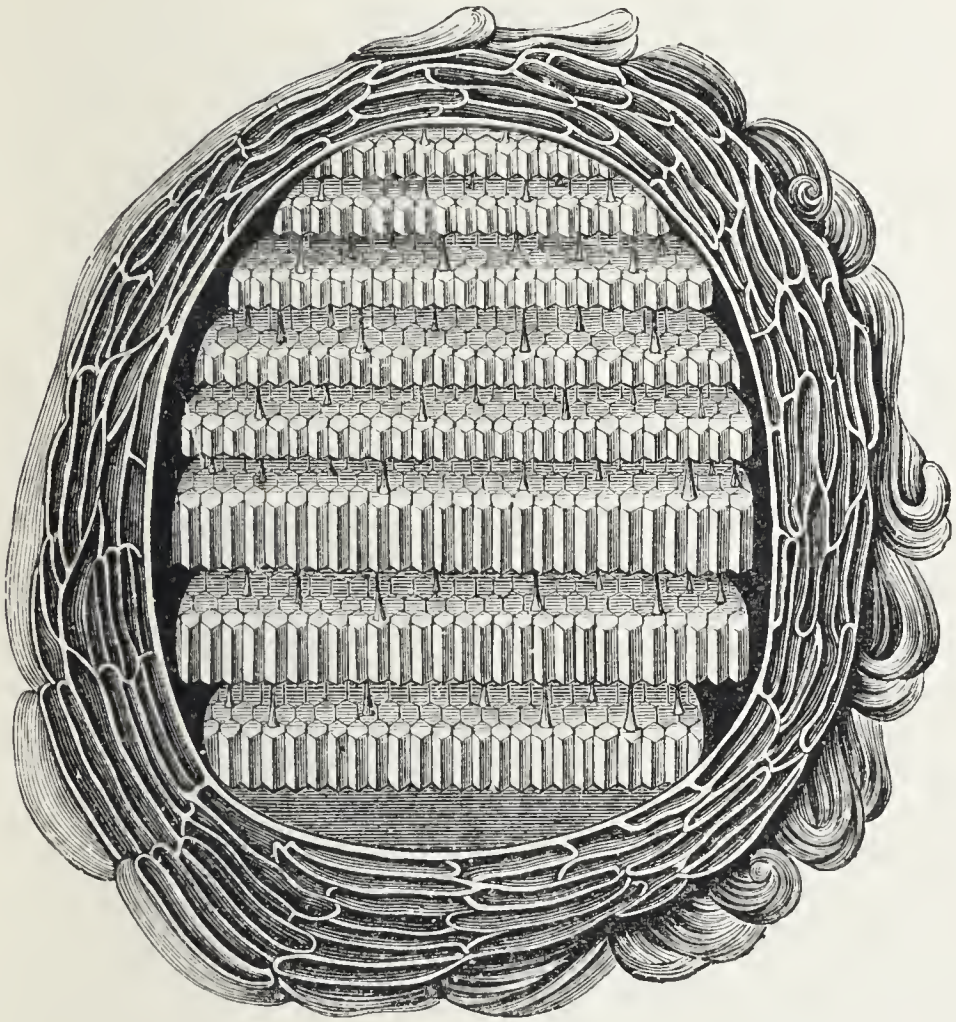
WASPS' NEST.

the legs and wings attached to it. But there was a breeze at the time, and this blowing against the wings turned the wasp round and round, and impeded his progress; whereupon he alighted on the gravel walk, and commenced cutting off first one wing and then the other, and flew away again. I have called this *reason*, and I think, with all your reasoning powers, you could not give a stronger illustration of it. But to return to my subject; you surely will not say that everything was made for your benefit only, and we *must* eat something to support life. However, I will not say anything further on this head, as you are, doubtless, more anxious to hear something of my life history.

'The recent beautiful warm spring induced me to leave my winter quarters, in search of some suitable place in which to make my nest for my future family. I flew slowly about in all directions, examining in my course every bank, and entering every crevice that I found in it, till, at last, I met with the deserted burrow made by a field mole, and after I had made a very careful examination of the spot, both inside the burrow and outside, I determined to take it. I at once commenced enlarging the premises, so as to contain myself and future family when finished. The chamber I had excavated was of an oval form, about 16 or 18 inches long, and 12 or 13 broad, so you may imagine my labours were very heavy, as I had no one to help me, and all the soil had to be removed and carried away. The house, as now completed, resembles very much that of my relations, the bees, but it differs in certain particulars. Mine, being entirely underground, cannot be seen, so I will describe it to you.

'I had to find and shape the material of which it was to be built. This was a paper-like substance formed of wood, very finely gnawed by my powerful

jaws, from some old palings. Then I gnawed away at the wood, cutting it into fibres, and making it up into pulp. With this I flew back into my burrow, and fixed it on to the roof, for, unlike your builders, the foundations of my house are at the top, and not at the bottom! This fixing of the pulp was done by my



INTERIOR OF WASPS' NEST.

jaws and front pair of feet, and formed a kind of hanging pillar, or as it has been called by one of your friends who was so fortunate as to see it, a "papier maché stalactite." This took some time to complete, and then the "comb" had to be made. I constructed and fixed to the lower end of the pillar three shallow

cup-shaped cells, their mouths (or entrance) being downwards, and deposited one egg in each, carefully attaching them to the side of the cells, so that they could not fall out; and having done this I put a cap over it. Other cells were added and more eggs laid in them.

'At the end of eight days, the eggs first laid were hatched, and three tiny babes or larvæ appeared; they were fleshy little creatures without feet, hence some people call them maggots, and they have a small round head and short bodies. They were hungry little mortals, and required much feeding and attention. Their food was made of insects, sugar, fruit and honey, which I had eaten and prepared carefully in my own stomach, so as to make it more digestible; and I was then able to bring it up again. With all this feeding they grew rapidly, so that I had to enlarge their cells; and here they were hanging head downwards; perhaps you wonder why they did not fall out. I will tell you. At first they fixed themselves by a gluey kind of substance, and afterwards, as they grew bigger, by the front part of their body, which is swollen and fills up the open part of the cell. The larvæ were now fourteen days old, they gave over eating, and spun a silken cap over their cells, and entered into their next stage, that is, they become pupæ, and ten days afterwards they came out as perfect wasps, and were very soon able to take some of the work off my hands.

'After the cell had been thoroughly cleaned out by the "workers," as they were now called, I laid more eggs until the first row or terrace of cells was quite filled, then some six-sided cells were made, forming a "comb." These combs are fixed to the sides of the nest—not like those of bees in two opposite layers, but in one only, with, as I have told you, the mouths

downwards (that is they hang vertically and not horizontally). Thus the upper part of the comb, composed of the bases of the cells, forms a nearly level floor (or terrace), on which we can pass and repass each other and the young ones can be fed, there being a space of about half an inch between each comb and the one below. Twelve or fifteen of these combs are made, forming what you will perhaps call "stories." In order to strengthen these, each is connected with that below it by a number of strong pillars, made of the same material as the cells, but of a more compact substance. The lower cells are much larger than the others, and you will, perhaps, like to know why. My family consists of males and females, but some of the latter are much smaller than the others, and we call these "workers," or sometimes "neuters." Not having any families of their own to look after, they do all the work of building the cells and feeding the young larvæ. They always occupy the smaller-celled combs —they are hatched in the earlier part of the year— whilst the males and larger females do not make their appearance until the end of the season, and they occupy the larger cells. Thus, in the course of a few months, my descendants have become very numerous. There may be 7,000 or 8,000 cells (or even double that number), and each cell may be the birthplace of three generations.

'I cannot say much in favour of my male descendants, they do not do any work, and many of them will I fear come to an untimely end. Even *I* do not expect to live through the coming winter. The workers also will die, and when the last generation of my descendants has arrived at maturity, our home will be broken up. Many of my grandchildren will, I regret to say, die from exposure to cold or what is

worse, from some violent death. Many of them, especially the males, will see very little of the world, and what females are left will look out for some snug quarter in which to spend the winter, and there they will remain until the spring, when they will come forth to be the mothers of future families, and perhaps, one of them will give you a call next spring. Some of the males and females in my house may not reach their perfect state at the end of this season, and alas! a sad fate awaits them. The workers will give up their kind attention to the helpless ones. They will pull them out of their cells, carry them away, and then abandon them. You shudder at this thought; but after all, may not their conduct be justifiable, when we know that the workers themselves will shortly die? And that, therefore, it is better to do this, than to leave their relations to die a slow and lingering death from starvation?

'Before I leave you I must make a few remarks regarding myself, and in doing this I hope you will not consider me vain or conceited. As to my appearance, if you can only divest yourself of the dislike you have for me, I think you must admit that appearances are decidedly in my favour. The beautiful colouring of my body is well worthy of your admiration; whilst my entire shape supplies you with the most perfect illustration of the class to which I belong—the division of my body into three distinct parts is so clearly seen. Let me call your attention to my wings. These are four in number, and are formed of a membranous material—hence the meaning of the term applied to my order, Hymenoptera—the first part here being the Greek for "membrane." Another peculiarity is seen in the hinder pair being much smaller than the front ones, and looking as if they had been cut out

of them. In connection with this there is a very remarkable contrivance in their construction, which is of special value to me, and affords a wonderful example of the way in which the Creator has designed every organ to our particular need. Your clever naturalist, Mr. Gosse, has described my wings so accurately, that I cannot do better than use his words. I may add that a small pocket lens will enable you to see the various parts. He says: "The hinder edge of the front pair, and the front edge of the hinder pair correspond; but it is necessary during flight, when they are expanded, that the two wings of each side should maintain this relative position, neither overlapping the other, but together presenting one broad surface, wherewith to beat the air. There must, therefore, be some contrivance for locking the two edges together, which shall also be capable of being unlocked at the will of the insect, and allow the wings during repose to slide over one another. This is done by a series of hairs or spines running along the front edge of the hind wing; they are bent up into strong hooks and stretching outwards. On the other hand, the margin of the front wings is strengthened and turned over with a shallow doubling, so as to make a groove into which the hooks catch; and thus while the forewings are expanded, the hooks of the hinder pair are firmly locked in their double edge, while as soon as flight ceases and the wings are relaxed, there is no hindrance to the sliding of the front over the hinder pair."

'I must briefly allude to that portion of my body which is situated at what the Americans call "the business end," and which is the special object of your dread—I allude to the sting. The males do not possess one, and in the females it is a modification of the

"ovipositor," which is the instrument by which our eggs are deposited in the place most appropriate to them. In addition to this, it is furnished with a strong poison, which is secreted by delicate poison glands resembling threads, but not nearly so thick as one of your hairs. These glands unite together at their bases and form a short common tube, which opens into a bag holding the poison until wanted. The base of the sting is connected with the poison bag, and when we wish to use it, two very sharp lancets pierce the skin and the poison flows down, to be injected into the wound. I can if you *like* give you an illustration of its use and ——.' The mere mention of this caused an involuntary move among her audience, and taking advantage of the confusion the wasp flew out of the window and was quickly out of sight, and doubtless glad enough to get to her home again in safety.

XIV

A Strange Dwelling

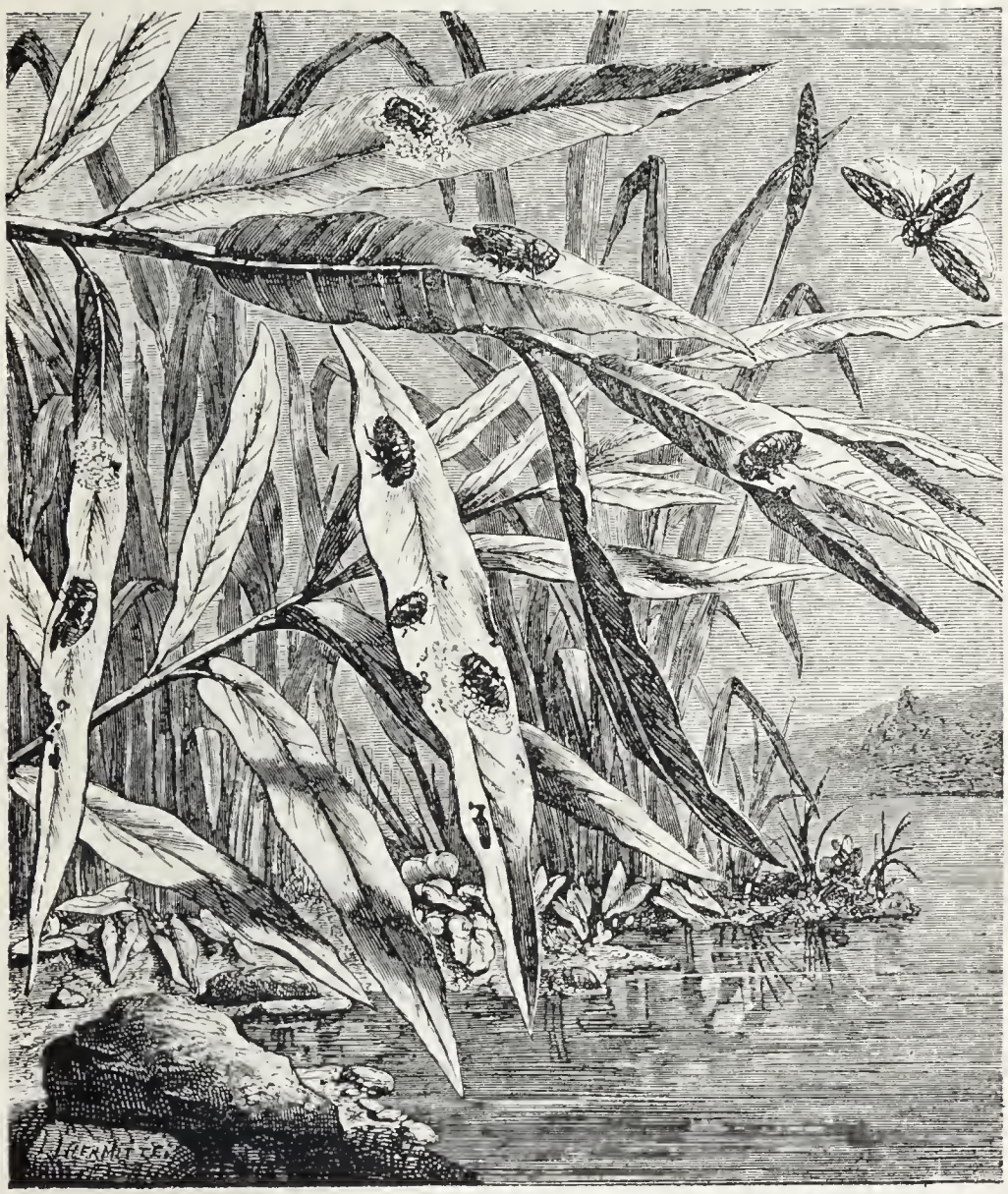
Cuckoo-spit (*Aphrophora spumaria*)

IN cutting flowers wherewith to ornament your drawing-room, it is not unlikely that you may have suddenly felt your fingers wetted, although the day was fine, and there was no dew upon the leaves. It is clear that it was not rain—what could it be? Whilst you are wondering, your eyes catch sight of a frothy substance on the twig in front of you; and if your curiosity leads you to make further examination, you will probably discover that this ball of froth contains in its interior a little soft yellow insect, with brown eyes. You would like to catch one? Well, mind how you proceed, or it will give you the slip, and with a sudden jump will disappear. If successful in capturing one, we will persuade him to tell us the story his life. Well caught! you have him! We will detain him for a few minutes. He begins :—

'Although not very often noticed, in consequence of my residence in this frothy covering by which I am concealed — and even when discovered, being driven away at once, as an unpleasant resident on your plant, I am worth a little attention; and when I have finished my story I hope I shall have succeeded in convincing you that I am not to be despised, although I am small

and insignificant, in comparison with some of my fellow creatures who have appeared before you. I have some very illustrious relations—the Cicada, which formed a favourite subject for the ancient Greek poets—the Lantern-flies of tropical countries—and others. The Aphis, who live all around us in such immense numbers, is also a near relation of mine, of whom I am not very proud, however. I am known by several names, more or less ridiculous in their origin. This is one of my "nicknames" shall I call it?—the Cuckoo-spit—an opinion having been generally entertained in former days that I was formed from the spittle of that well-known bird. Whilst your Continental neighbours, as well as yourselves, connect me with frogs, and call me the frog-hopper. This may probably be from my habit of hopping or jumping, as is common among that cold-blooded race. In our perfect state we all jump with great agility, our hind legs being chiefly employed.

'I am speaking now from my own observation, as I am at present in my larval state. I do not go through any marked changes in my life, being very like my parents from my birth—of course I have no wings—but in my next stage, that of pupa, my wings will appear in a rudimentary form, attaining their full development in my perfect state. Should you then meet me, you will see that I have four, all membranous, and all of the same structure, and from this my order derives its name of Homoptera. My wings, as you see them with your unaided eyes, are not particularly beautiful, but under a strong microscope their groundwork will be found to be composed of a membranous network, and upon it are an innumerable number of round eye-like spots, of uniform size, arranged in irregular transverse rows. Each spot has a dark centre surrounded by a white transparent line, and is separated from the spot near it



CUCKOO-SPIT.

by a space about as large as the spot itself; these spots are little tubercles. With an ordinary lens, the above appearance very much resembles shagreen.

'My life is a curious one. I live comfortably inside what looks like froth, and it is from this circumstance that your learned men have given me the name of Aphrophora, or "foam-bearing." This seems a long name for such a small insect as myself! This froth, or foam, is formed of bubbles, and as they burst, the water of which they are formed drops to the bottom of the froth. When the drop becomes too large to be upheld, it falls to the ground, and another drop takes its place. But you will perhaps be wondering where the water comes from. The trees or plants upon which I live all contain a large amount of sap. My mouth is formed for suction, but instead of driving my beak into other animals, as is the practice with some of my fellow-creatures, mine is used to pierce the young and tender twigs, and to suck out their sap; what I do not further require as food covers me over, and that is how the water gets there. One of my relations now living in Madagascar draws out or distils a very considerable amount of clear and apparently pure water, which is said to be quite astonishing.

'I shall soon be full grown, and then enter my pupa state, and after the lapse of a few days appear in my perfect or imago state, and leave my present dwelling altogether. Perhaps when you are examining your chrysanthemums during the summer, you may see me, as a small dark brown creature, with several yellow or whitish bands across my elytra, lying quietly in the hollow of some leaf. Should you touch me, it will probably be the last time you will see me; and this, because I have hopped away to a considerable distance. This is why we are more generally known in our perfect

state as the Frog-hopper. My hind legs you will then see are very long, and when about to jump, I bend the shank close up to my thigh, and then, suddenly straightening it out with a jerk, and with the further assistance of my wings, I shall be able to leap a distance of five or six feet, or two hundred and fifty times my own length! One of your writers says that this is equal to a man jumping four hundred yards without taking a run! But even now my jumping powers are considerable, as you can judge for yourselves.'

Saying this, he gave us a practical illustration of his powers, and with a long hop disappeared—somewhere!

XV

Two Skilled Oarsmen

The Water Boatman (*Notonecta glauca*); and Corixa Geoffroyi (no popular name)

IT is a bright summer day. As we stand by the side of a clear pond and look down into it, we see living creatures of various kinds swimming about in all directions. Some of these we have already 'interviewed,' but there yet remain others, and the life history of two of them may prove of interest. They are very common, and with the aid of a small hand-net we shall have little difficulty in capturing them. Here is one swimming very near, just below the surface, and we notice a peculiarity in it—that is, while all the others that we have seen swim with the back upwards, he is doing so in a reverse position, or back downwards. We have caught him, and having apologised to him for the shock that our sudden capture may have given him, we explain our object, and he at once consents.

'I am known to all of you who take an interest in aquatic subjects as the Water Boatman, and I can therefore readily understand your wish to hear something about my career. In the language of naturalists I am known as *Notonecta*—a word signifying that I swim upon my back, and in doing so I bear a strong resemblance to a boatman. I do not wish to say anything

that will hurt your feelings, especially as I may be addressing some skilful oarsman ; but there is one way in which I far surpass anything that you can do—I can row along below the surface quite as readily as you can on it, without experiencing any inconvenience. Some of your people have made boats or ships which you profess to be able to navigate under water, but such inventions have not come to much ; the difficulty of getting a supply of fresh air is one that you cannot very well get over. Now as to my life.

WATER BOATMAN AND CORIXA.

'The eggs from which my brothers and sisters were hatched were of an oval form, and had been deposited by our mother in the stalk of one of the aquatic plants. She did it in this way. Holding firmly on to the stalk by her fore and middle legs, she buried her beak into the plant, and so gained additional support ; she then made an incision with her ovipositor by moving it backwards and forwards, as you would use a saw ; this did not take more than a minute. Then an egg was passed into the cut thus made, about one-third of it, or the head end of it, remaining outside. In about fifteen days I made my escape from the egg ; this was about the beginning of spring, and my mother survived until I had arrived at

maturity. In both my conditions, namely as larva and pupa, I differed very little from what you now see me in my perfect state, except that I was unable to fly. In my pupa state my wings were enclosed in small flat tubercles (or swellings) on my back. The boat-like form of my body is readily seen as I rest in the water. I have three pairs of legs ; the two hinder ones are very long, and when I stretch them out from my body they look exactly like a pair of oars ; and that is just what they are. Their ends are furnished with hairy fingers, and these act like the blade of your oars, and enable me to drive myself along at great speed. What you call "feathering," or turning the edge of the blade towards the air as the oar is swept backwards for the next stroke, is in my case done by the bristles, which stand out as my leg is forced against the water, but fall together when returning backwards. If this was not done, why, of course, I should travel nearly as fast backwards as forwards. Another difference in our rowing is, that my oars are never lifted out of the water ; you will see all this better when I return to the water.

'I am not by any means confined to this pond, for, having four large and strong wings, I frequently take excursions into the air. My front pair are larger than the hinder pair, and when I am not using them they lap partly over each other ; the part attached to my body is leathery, whilst the tip is membranous ; it is this structure that gives my order the name Heteroptera.

'I have no difficulty in rising from the water. It is a simple process ; all I have to do is to go a little distance below the surface, and then, turning my head upward, I give several short, quick strokes with my oars ; this jerks me quite out of the water. My young friends among you do very much like this when they take a short run to help them in jumping over a ditch. Immediately I

am in the air I open my wings quickly and commence flying.

'I breathe in and out of the water in the same way as most of my fellow creatures in this pond. You have heard that we do not breathe through our nose, as you do, but by certain little openings called spiracles, arranged along the sides of our body. I just bring my tail to the surface. A small quantity of air is inclosed between my elytra and body, and this enters the spiracles and passes into large air-tubes, or tracheæ, and so is distributed through my body. When flying, the air enters at once through the spiracles. In the water I have to come up at intervals in order to get a fresh supply.

'The chief portion of my time is occupied in getting my food. My prey is seized by my forelegs, and is clasped tightly to my body. My mouth is not provided with jaws for biting, as you have seen in some other insects, but with an apparatus especially designed for sucking. This is a strong and rather long proboscis, or beak, which I plunge deeply into my prey, and then suck out the juices from its body. If you are not very careful how you hold me, you may possibly have a proof of its power. I have heard from one of your friends that it resembles a pierce from a red-hot needle, and causes a sharp stinging pain, but as no poison is injected into the wound it soon passes away.'

The idea of a red-hot needle piercing our finger made us leave go of the Boatman, who took advantage of his freedom and darted into the water; and then coming up quickly, as he had described to us, he again entered the air, and, with a loud, dull, humming sound, flew away, probably to visit some other pond where 'interviewers' are not known.

While listening to the above narration, we had noticed

other creatures swimming about; one of these, coming up to the surface, voluntarily offered to tell us his history. We thanked him, and he began:

'I belong to the same order as the Water Boatman. I shall not detain you many minutes. My name is *Corixa Geoffroyi*; I am not known to you by any popular name. Although I am a near relation of the Boatman, there are some slight differences between us, about which you may like to hear. I do not swim on my back as he does, and I resemble a raft rather than a boat. My mode of breathing differs also; I do not, as you saw him, bring my tail to the surface when I wish for a fresh supply of air, but I rest for a moment in a horizontal position, then, tilting my head a little downwards, the air enters directly into the spiracles on my chest. I should also like to call your attention to my elytra, which are beautifully marked with dark spots of various forms, and I have often thought that a copy of them would make a good design for chintz or floorcloth, or something of that kind. We fly by night, and occasionally during the summer visit your homes, being attracted by a light. During the winter months we endeavour to keep warm by burying ourselves in the mud at the bottom of the pool. Sometimes you may see large numbers of us huddled together at the surface of the water beneath the ice. A very remarkable incident is mentioned in connection with my relations. It is stated that, in 1883, thousands of them fell from the air during a storm in Turkestan, coming down like rain in such enormous quantities as actually to extinguish a fire where some travellers were bivouacking.'

XVI

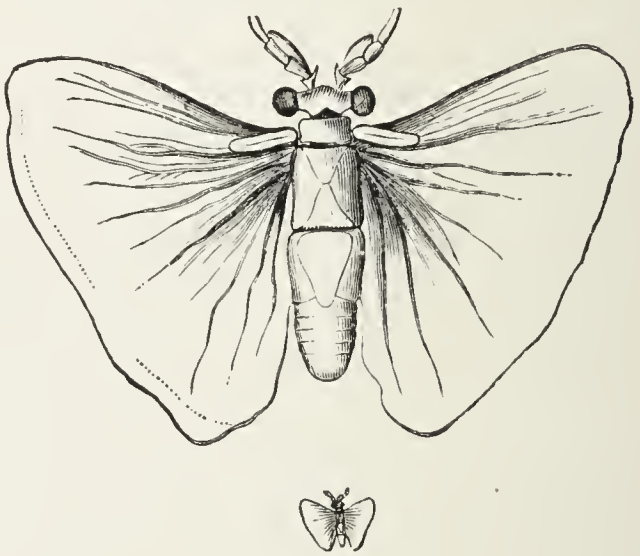
An Unwelcome Guest

(*Stylops Kelittæ*)

OUR next entertainer is one of very small size, not being one-quarter of an inch in length, and is known as a "parasite,"—that is, it lives in the body of another insect. It had been often seen by naturalists before its true character was discovered. It had hitherto been looked upon simply as a little mite (one of the acări, or minūte creatures well known to infest bees, beetles, wasps, and other insects). The bee which it specially troubles by its presence is a species of Andrena. These insects burrow in loose sand, or in ground, hard, or even very hard. Some are very common. Here is one; we examine it with the aid of a pocket lens, and we see something appearing from beneath one of the segments of the body. This proves to be the object of our search—the parasite. He has only just come out of his pupa state, and will soon be flying away; so without further delay we will get him to speak for himself.

'You have just heard that the place where I take up my abode during the earlier portion of my life, is the inside of this Andrena. This is, no doubt, the cause of considerable unpleasantness to him. It has been truly said by one of your race that "half the world does not

know how the other half lives," and I can quite imagine your astonishment when you first heard about me. It would be considered hypocritical for me to express any regret at having caused Andrena any inconvenience, and you would perhaps say, "Why did you take up your abode there?" or "Now you know it is unpleasant to him, why do you not leave at once?" You will get an answer to these questions as I proceed. It was in the year 1802 that the discovery of our residence was first



STYLOPS.

made by Mr. Kirby. His account of the discovery will interest you; at the same time I cannot say that he is very complimentary in some of his remarks about my ancestor. First of all he took him for a mite, like one of those things you see on cheese, sticking to the bee. Then he tried to pull him off; and he goes on to say: "You may imagine how greatly my astonishment was increased when, after I had drawn it out a little way, I saw its skin burst, and a head as black as ink, with large staring eyes, and antennæ consisting of two branches, break forth and move itself briskly from side to side.

It looked like a little imp of darkness just emerging from the lower regions. My eagerness to set free from its confinement this extraordinary animal may be easily conjectured. Indeed, I was impatient to become better acquainted with so singular a creature." Then, when he had done all this, he tried to find out his relations, and what position he held in his family. But that puzzled him completely. My ancestor's eyes and wings would not allow him to be placed in one order; then he was not sufficiently like another order to be included in it, and so at last he was obliged to make a new order on purpose for him. And because the elytra were distorted, or twisted, he called it Strepsiptera, which means "twisted wings." So you see how a little creature can puzzle your learned men. But you would like to hear something about my life.

'The egg which contained me was deposited by my mother in the interior of this bee, by the aid of an instrument with which she was provided, called an "ovipositor." I was no sooner hatched than I commenced feeding upon my unwilling host. I cannot say positively that my doing so caused him any particular inconvenience, as all the time I have been with him he has been active, and has associated with his companions. When full grown, I wished to see a little of the world, so I stretched my head out between the segments of its body, and then it was that I might have appeared like a mite. I was then nearly cylindrical in shape, fleshy, about one-quarter of an inch long, and white. My head was flattened, and attached to my body by a narrow neck; this was when first stretched out, but it soon became rounder and almost black. Shortly after this I assumed my pupa state. This was his condition when my ancestor was first discovered. I have only just entered my perfect state.

'I am afraid you will not be able to see my elytra, so small are they; but if you can, you will notice the propriety of the name of my order: they are short, slender, and twisted. My hinder pair of wings are enormously large in proportion to the size of my body, and open out like a wide fan, the front and hinder margin extending from my head to my tail. I fly well, and my chest is very large; that is, nearly twice as large as my head and body together; this is in order to give attachment for the powerful muscles required to move my wings. You will observe a peculiarity in my antennæ—they are doubly branched, so that you might imagine I had four instead of two only. My eyes also are remarkable. Some of us have them set on stalks of greater or lesser length, and they are still further peculiar for the very few facets (or single lenses) that they contain compared with many others of my fellow creatures; whilst some of them, as you have heard, count them by thousands and tens of thousands, we have only ten.

'I must now take my leave of you, as well also of Andrena. I hope this account of my life history has interested you, and that it has in some degree helped to remove some of the prejudice you may have felt against me in consequence of my being a parasite, and living on, and at the expense of, another. Should you see me fly away, you may perhaps notice a peculiar milky look about my wings, which will enable you to recognise me again at any time, as it is characteristic of me and my relations.'

XVII

The Experiences of Two Great Divers

The Chameleon Fly and the Drone Fly

(Stratiomys chameleon, Eristalis tenax)

WE were watching the unusually quick motions of what looked to us very like a bee, when he flew up to us, and, settling upon a flower, gave us the following interesting account of himself:

'From the interest with which you appear to watch my movements as I rapidly flit from flower to flower this lovely day (by the aid of my two strong wings, for I belong to the order Diptera), you will probably like to hear something of my life history. Seeing me now, you can hardly imagine the very different manner in which the earlier portions of my life were spent. I am known as the Chameleon Fly, and it was beneath the surface of the water in a clear pond that I made my first entrance into life. My mother had with great care deposited her eggs, containing me and numerous brothers and sisters, on the under side of the leaves of the water plantain (*Alisma plantago*). They were arranged very like the tiles on the top of a house; that is, each egg partly overlapped its neighbour. The egg which con-

tained me was white at first, but changed gradually to an olive green. After remaining in it for some days, I escaped from the shell and dropped into the water, appearing in a form as unlike as possible that in which you now see me. Instead of having a pair of wings and a broad black body, marked with these various yellow markings, I was long and tapering from my head towards my tail, and when I attained my full growth was about 1½ inches in length. My body consisted of my head and eleven joints. My head was small in proportion to my length, and was horny and pointed in front. My mouth was furnished with two hooks, four small joints, and two feelers, expanded at the tips and covered with hairs, all bending backwards. These feelers I was in the habit of keeping in continual motion, thus forming a constant current, by which means my food, which consisted chiefly of very small creatures, was brought to my mouth, for, strange as it may appear to you, I was unable to run after it, not having any legs except the two hooks I have spoken of at the sides of my mouth. I may really call these legs—they had three joints—and it was by their means that I could walk at the bottom, crawl out of the water, or swim about head downwards when my tail was at the surface. And that reminds me that I have not yet told you how I managed to breathe all the time.

'The air as you breathe it was equally necessary to me, and consequently I had to come up to the surface at intervals to get a fresh supply. Having got this, I could then remain some time below. Your divers have the air sent down to them by the men in the boat at the surface; but Nature, who does all things so skilfully, enables me to take down my own supply of air. If you should ever see one of my relations at the time of life I

CHAMELEON FLY.

am now describing, and which is called the larva or larval state, you will notice that the last joint of the body is very long, and that at the extremity is a small opening to receive the air. Around this is a circle of about thirty spreading rays, forming a coronet of beautifully feathered plumes, and which can be closed at pleasure. The hairs (or plumes) repel the water, and thus our body is kept at the surface and in contact with the air. When we desire to go down again, the plumes are turned down,—like the fingers of your hand over the palm,—a small bubble of air is enclosed, and the opening is shut, the air enters the air tubes inside our body, and so we breathe until a fresh supply is wanted.

'In course of time we become full grown as larvæ, and then prepare for entering upon our next, or pupa, state. In first meeeting with us in the pupa state, it is probable that you would not notice anything particular. Our colour is still greenish and we are still the same shape. It is indeed my old larval case in which I have changed. On touching me you will find me harder, and not flexible as before, and further examination will show you that in my pupa state I am much smaller than I was before, so that, a large portion of the case being empty, it is now much lighter, and hence floats about on the surface, head upwards. The empty or tail portion of my old case serves now as an air-chamber, and contains what little air I then require. So we remain a few days, when an opening is made in the upper part, and we escape in the form you now see me, leaving the water entirely, and passing the remainder of our lives as inhabitants of the air.

'But here comes the Drone Fly or Rat-tail Maggot, not very unlike me; indeed, he belongs to the same order as myself. He also once lived in the water, and the way in which he passed his early days there is more

DRONE FLY.

remarkable than mine, and his method of diving very peculiar. You may persuade him to tell you all about it.'

Saying this, the Chameleon Fly flew off to another flower, and we saw no more of him.

With this the Drone Fly commenced his story :

'You would like to hear something of my previous life? Well, it has not always been so pleasant a one as now, or even as that of my friend who has just left you, but it has been a curious one. I began life in the mud at the bottom of a shallow but very dirty pool. This was where we had to obtain our livelihood, and perhaps those of your race who work in drains and sewers would hardly like to change places with us; but we were well provided with all we wanted for our work. In my first state after leaving the egg my body was much like one of those creatures that you see in decomposing meat, but not quite so clean-looking!

'I had seven pairs of membranous feet, which were provided with hooks. I had also a long tail, and this it was that enabled me to get my living in the mud at the bottom of the water. It not being of any use, however, in my present condition, I no longer possess it. I will try and explain it to you. It is in form like a telescope —one of those small ones that shut together. The thick part of the instrument may be compared to my body, and the tubes which slide into each other and can be drawn out represent my breathing tube, only you must know that the tubes in my tail were very flexible—no stiffness at all about them! Now this was its great use to me. The food upon which I live is found in the mud at the bottom of the pool or puddle, and the object of these long flexible tubes is to enable me to breathe freely whilst at the bottom without constantly coming

up to the surface for a fresh supply of air. When living in very shallow water, the smaller tube is withdrawn into the larger one. The smaller tube is double—that is, there are two tubes running parallel to each other, and when not in use the two are coiled together at the bottom of the larger tube, and, notwithstanding their length and fineness, they never get entangled in their folding and unfolding. Then the passage is always perfectly clear for the admission of air. This is a far more beautiful arrangement than is adopted by your divers, to whom the air has to be forced down a tube, and who are apt to be suffocated, if anything fails in the action of the apparatus. Our breathing tubes can be drawn out to a great length, so much as twelve times the length of the body; so you are able to judge as to the depth under water that we are able to work; and when they are drawn out, you can imagine how very fine the tube must be. You will perhaps wonder why I live in such a place; but you know that the Creator, in forming every creature, designed it for some special purpose. My work, therefore, in feeding upon this (to you) poisonous mud is to destroy its dangerous qualities, and so render it harmless.

'When I had arrived at my full growth as a larva, I left the black mud in which I had hitherto found my living, and crawling ashore by means of my seven pairs of small hooked feet, I selected a suitable spot where to bury myself, and so prepare for my next stage of existence. My skin at length shrank and became hard, and formed a case (or cocoon), in which I quietly passed into my pupa condition. In process of time my body had undergone the change necessary to fit me for my present life, and I escaped into the air in the form you now see me. It is possible you may have

seen me often; but I am in many ways so like a bee, that you no doubt have frequently mistaken me for one.'

(Here the Drone Fly made a sudden movement, and we failed to see him again.)

XVIII

A Tale from a Tub

Common Gnat (*Culex pipiens*)

IN the backyard stands an old water-butt by the side of the house, so placed as to catch the rain-water as it flows off the roof. The water does not look as if it had recently dropped from the clouds, but is black, and has an odour which is not very pleasant. Decaying leaves and other things have fallen into it, and some are floating on the top, so that altogether it does not present a very attractive appearance. But whilst we are looking down into it we see some small creatures wriggling about at the surface, and then disappearing into the dark depths below. We will make a dip and catch some of them, and place them in a saucer, so that we may learn something about them. We find that we have among other objects a gnat, and from him it is that we get the following particulars:

'My dear friends—I hope you will allow me to use that term, although I must confess that many of my relations do at times make themselves rather disagreeable; but I hope you will pardon any little inconvenience they may have caused you, particularly when you remember that it was the Creator who thus designed

them to obtain their living at the expense of a very tiny drop of your noble blood. My life has seen many changes, and an account of them will, I feel sure, prove very interesting to you.

'I must commence my short autobiography, then, by telling you, with a certain amount of pride, that my family occupies the foremost rank in the order to which it belongs, and which, in the language applied to us, is called Diptera, meaning that we have two wings. It is, moreover, owing to the more complete development of our mouth and tongue—those very members which cause you the temporary annoyance—that we attain a high position in our family. I have not always been the active aërial creature that you behold me now; for the earlier part of my existence—that is, for the first twenty-eight or thirty days—I lived entirely in the water, being then like the wriggling worms in this water-butt.

'My mother took great care to provide for her large family. This was no easy task, as you may imagine when I tell you that I had no less than 300 brothers and sisters. A little cell or egg, of a long, oval form, and having a small and narrow knot at the top, contained each of us; and as these cells are heavier than water, and therefore will not stand upright in it, my mother formed a little boat or raft capable of floating upon the surface of the water quite securely. It was made entirely of eggs, fastened together side by side, and its construction was rendered very difficult by its having to be built upon the water, and not launched afterwards, as is the way amongst your boat-builders. As you now see me, I resemble my mother as she was at that time. She was therefore unable to live in, or to swim on, the water, as she had been accustomed to do in her earlier days; hence she was obliged to avail herself of a leaf or bit of stick on which to float during her arduous

COMMON GNAT.

task. Having fixed herself by her four front legs upon this stick, she stretched out behind her, her two hind legs, and crossed them over one another somewhat in this fashion X. Now just where her legs were crossed she placed the first egg, and then by its side glued another to it, and then another. The eggs thus fixed together floated, and so she went on adding egg after egg until 300 were laid, each in its proper place by her hind legs, all forming a little hollow boat. Then, having taken a final glance at us all, she flew away, and we were left to ourselves, each in his own little cell. The wind might blow and the waves rise, but still, like one of your lifeboats, we were never upset. A curious gentleman named Kirby once tried to sink the boats of some of my ancestors by bringing them under a water-spout, but he was quite unable to carry out his intention—still they floated.

'We continued floating about on the surface of the water for three days, at the end of which time, having become larvæ, we descended head foremost through a lid at the bottom of our cells into the water, leaving our empty boat behind us. At this time we were about half an inch in length. We brothers and sisters soon parted company with one another, so I must now continue with my own history alone. At this period of my life I must confess that I was a somewhat singular-looking creature. A glance at one of my young relations now in the water-butt will show you what I was like. My colour was greenish and semi-transparent, my head large and round, my jaws also were large, and provided with little hairs, by the aid of which I was able to make currents in the water, thus to bring food to my mouth. My head and chest (thorax), formed of three segments, were much larger than the remaining nine segments of my body. The eighth was furnished

with a long organ terminated by a star, whilst the last joint was terminated by stiff hairs, and by five slender conical plates. These hairs were coated with an oily matter which repelled the water, and, when we were at rest, helped to support us at the surface.

'If you notice the larvæ swimming about, you will see that they are continually bringing their tails to the surface; this is in order to get a supply of air through the long tube on the eighth segment. Having drawn a little air through the tube, it is thence conveyed by smaller tubes into the interior of their bodies. Now they close the star and descend to the bottom, but not without a little effort on their part, as the air just taken in has made their bodies lighter than the water. There is thus no danger of their remaining below and being drowned, as on leaving off their exertion they will ascend to the surface immediately.

'In this way I too passed fifteen days, during which time I had grown so large that I had to change my skin (or to moult). This I did on three successive occasions, when one day I underwent a change in my state and appearance. I had now become a pupa. I cannot say that my personal appearance was improved by the change. I did not enclose myself in a case or cocoon, nor did I remain quiet in this stage, but I was now as active as ever. My head and shoulders were very large, and you would probably consider them out of proportion to the rest of my body. But the most remarkable change was in my mode of breathing. It was not necessary for me to bring my tail to the surface any more; what I had to do now was to put my shoulders out of the water. If you look at one of us in the pupa state, you will see two little tubes somewhat resembling horns, and it is through these that we inhale the air necessary for respiration. My body was at this time

curved, and terminated by two slender oval plates, which served me as a rudder, by the help of which I moved freely about from place to place. As you may have noticed, the pupæ and larvæ in the tub swim in very different ways.

'About ten days had passed over me in this stage, when the most critical period of my life approached. I was now about to enter upon my "perfect" state, and to leave the water—the scene of my earliest joys and pleasures—at once and for ever. The sun was shining brightly upon the surface of my home as I rose for the last time. My limbs had gained strength. I stretched out my body, and in so doing raised my chest above the water. I swelled my chest out, and so made a slit in my old skin, which in this stage was only, as it were, a shell or covering for me whilst preparing for my perfect condition. Out of this skin I cautiously pushed my head and chest, and by degrees more and more of my body, until my shell was nearly empty. In this condition I was perfectly helpless. The least breath of air alarmed me, for should I be upset now, I must have been drowned! I regret to say that numbers of my relations have thus come to an untimely end. A little more exertion, however, enabled me to free first my two front legs from the case, then the next pair. Feeling somewhat safer now, I placed my feet upon the water, which supported me, my weight being so trifling, and I could then easily extricate my hind legs and wings.

'A very short time sufficed for me to expand them. The warmth of the sun soon dried them, and I felt that I was gaining strength rapidly. I had now a strong inclination to make use of my wings, and so I took my first flight, the delights of which I shall never forget as long as I live. A number of my brothers, who, like myself, had just left the home of their childhood, were

disporting themselves in the air, whereas we could seldom induce our sisters to join in our sports.

'Before I take my leave of you, I will, with your permission, show you a little of my beauty, not from any feeling of vanity or love of admiration on my part, but with the simple object of making you better ac-acquainted with the works of the Creator. First of all, then, let me call your attention to my eyes. These are two in number, and are large, occupying the greater portion of each side of my head. Some of my fellow creatures are provided with several simple eyes or *ocelli*, situated on the upper part of the head as well. I only have the two large or "compound eyes," as they are called, from their being formed of a large number of simple eyes. If you look at my eye through a lens, it will remind you of a piece of network. Each division (or facet) is hexagonal, and the number of these in one eye varies very considerably in different members of my class. In the ant, for instance, each compound eye is made up of only fifty of these facets; the small fly which visits your houses during the summer has about 4,000; the dragon-fly, whose interesting history you have heard, has 12,000; and a small beetle (*mordella*) no fewer than 25,000! Every one of these eyes is furnished with all the apparatus necessary for distinct vision; but you must not therefore imagine that we see as many different objects as we have facets; that would be very confusing indeed; but as it is each facet sees only a very small portion of the object before it; each consequently sees a different portion to the facet on either side of it; and as these all fit exactly into each other, I get a complete picture of the whole object, just as in a dissected map, when all the pieces are fitted together, you get the complete map. On my head you will also perceive two light and elegant plumes, or

antennæ, as they are called. Each of them is formed of a slender cylindrical stem, composed of thirteen joints, and a bulb from which it rises from my head. At each joint there springs out a whirl of fine hairs, very long in my case, but short and few in number in my sisters. These organs are very important, as it is by them that we are enabled to hear, smell, and feel. By the side of the antennæ are other organs called "palpi."

'When I commenced addressing you, I mentioned the annoyance caused by some of us. The means by which this is done is very remarkable. In order to explain it more fully I must introduce you to one of my sisters, as it is they only who have attained such skill in puncturing your delicate skin. Without wishing to hurt their feelings, I must add that we, their brothers, are quite innocent of any share in this sanguinary proceeding. And they will perhaps retort that this forbearance on our part is only because we have not the necessary implements. Now, looking at my sister's mouth, you will see that between the palpi there projects a long cylinder, which represents the lower lip or labium, and which swells slightly near the tip into several minute lobes. The greater part of this lip is covered with scales and short arched hairs, and its upper surface is deeply grooved. Inside the groove lie several filaments of great elasticity and firmness. One pair of these are the mandibles (or upper jaw), having somewhat the appearance of a blade. Their points are exceedingly sharp. The edge at this part has nine teeth pointing backwards, but the remainder is smooth. Next to these mandibles you will see the maxillæ (or lower jaws). They are as long as the mandibles, but are simple cutting lancets. Then there is the tongue, which is tubular, having a sharp blade on each side of it, and

when not in use it lies in a hollow in the upper lip. The length of these instruments is about one-sixteenth of an inch, and the whole of these parts is called the rostrum or proboscis. Now as to the way of using it. My sister, having alighted upon an uncovered part of your skin, lowers the proboscis, and pierces the skin by means of the barbed lancets, pushing them gradually deeper and deeper into the skin. In doing this the lower lip, in which they were enclosed, becomes more and more bent, like an elbow, towards the breast, until the whole length of the lancet is introduced into the skin. It is not the puncturing which causes you the annoyance, but the injection of a certain liquid which enables the minute drop of blood to flow faster. In the absence of this, their favourite food, my sisters, like myself, feed upon the nectar of flowers. The humming noise which you hear on our approach is produced by the rapid vibration of my sister's wings. During flight these number as many as 3,000 in a minute.

'Our wings, two in number, are clear, elastic membranes, covered on both sides with short, shiny hairs, very numerous and very small. Parts of them are also covered with leaf-like scales. The second pair of wings are replaced by a pair of what are called halteres or balancers, the precise use of which is not clearly understood by your learned men. My breathing is now carried on in a manner different to the two modes I have described, and is effected by little openings or spiracles on my sides, such as you have already heard described. Small though we are, we sometimes cause great excitement among men. In the year 1736 my ancestors visited Salisbury in great numbers. At a distance they resembled a cloud of smoke, which occasioned many of the inhabitants to think that the cathedral was on fire. Our family records contain several similar in-

stances. I have heard that a King of Persia was once compelled to raise the siege of a town, in consequence of vast numbers of my ancestors attacking his elephants and beasts of burden, and so causing the rout of his army. I have some relations residing in tropical countries who are held in great detestation by your race—I mean the mosquitoes, and I do not feel surprised at it. But it is time now that I should conclude my history, and join my brothers in their merry sports.'

Hardly had he said these words than he flew away, and was lost among his numerous companions.

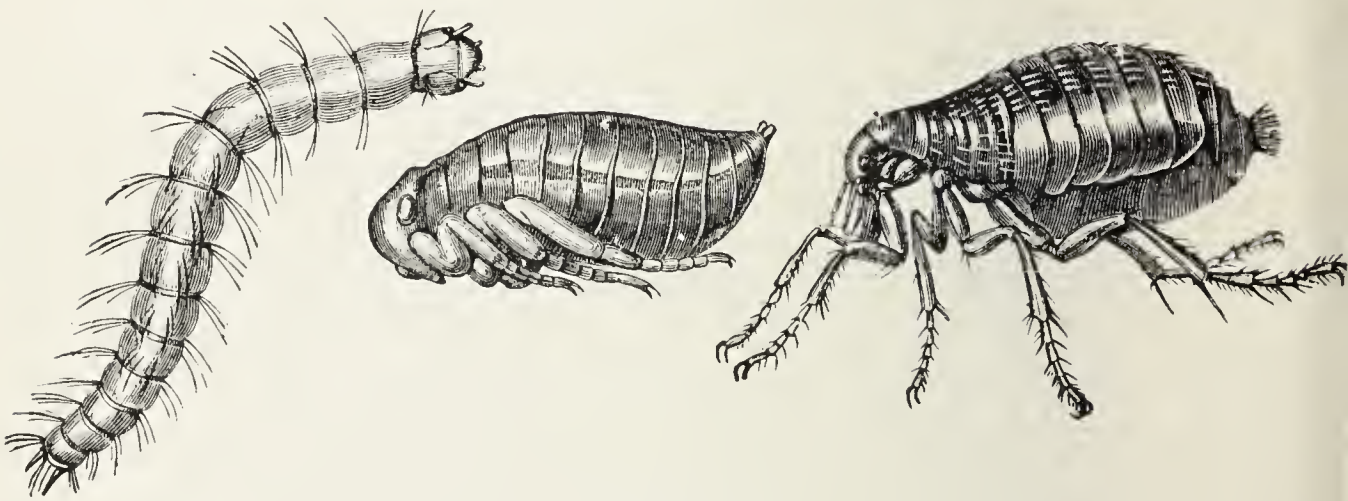
XIX

A Great Athlete

The Flea (*Pulex irritans*)

FOR these last 'Reminiscences' we shall try to secure an insect which is made well known to us by two of our senses—sight and feeling. During the summer months she frequently reminds us of her presence ; and anxious though we may be to get rid of her company, it is not always easily managed. 'Here it is ! I have it securely held between my finger and thumb.' So you say ! Slowly and carefully you open them to allow of a view of it, until you discover at last that it is 'conspicuous by its absence.' You lift your eyes up in amazement, and then, perhaps, at the distance of a foot or two, you see a small dark speck. Like a cat after a mouse, you approach it very slowly, and then, when within a few inches of it, you make a spring at it ; and almost at the same time you again notice the same dark little speck at some distance from your finger ends ! But perhaps you succeed in capturing it, as we have managed to do. So before she gets away, let us try and persuade her to trust herself between our fingers for a short time, whilst she gives us her 'Reminiscences.' She arranges herself comfortably, and then begins :

'Having heard what that great architect—the wasp—said about the abhorrence and dislike by which she is regarded by your race, I feel somewhat reluctant to appear before you to give you any account of my life, knowing that all she said applies to myself also; and I am not quite sure that it does not do so in a greater degree. Only once do I remember hearing any of us being well spoken of; and that was by an old lady who said we were "the prettiest little merry things in the world. I never saw a dull flea in all my life!" With-



COMMON FLEA.

out in any way wishing to "blow my own trumpet" too loudly, I may be permitted to say that I consider myself a very wonderful creature in certain respects; not, perhaps, from your point of view; but, as you have expressed the wish to hear me, I shall trust myself in your hands, whilst I endeavour to show you how wonderfully all my body is adapted to my particular mode of life.

'My full name, as given me by learned men, is *Pulex irritans*, the latter word, as I take it, signifying the irritability which your race displays when my presence becomes known! Commencing with my earliest days, my first recollection, after escaping from the oblong egg which my mother had deposited in an out-of-the-way

spot on the drawing-room hearthrug, was to find myself in company with about a dozen brothers and sisters, who had also just been hatched. I believe between six and twelve days had passed since our mother laid us there; but not having seen her, so far as I know (I doubt whether I should recognise her if we did meet), I have never been able to decide this point. I do not even know whether my mother is alive, or how old she was. I have heard of one of my ancestors who lived eighteen months, although he had had a hard life—for he was a public performer. He used to astonish the public by pulling up a little bucket from a well. I believe he died of old age. He was one day found dead, faithful to his post, with his bucket drawn half way up the well.

'My first appearance was as a maggot, as you would call it (but I prefer larva). I had no legs, but yet was able to push myself along by means of hairs attached to the segments of my body; and, considering my legless condition, I was very active, twisting about in all directions in search of food. I cannot at this distant period say what I did feed upon. At all events, I grew rapidly; and in about twelve days had attained my full size; and then I enclosed myself in a small silken cocoon, and became a pupa. Here I remained about a fortnight quite inactive, whilst six legs were being prepared for my future use. I should tell you that I was hatched in the summer. Those of my relations that are hatched in the autumn pass the winter in the larval state, changing to pupæ in the following spring.

'But to return to my own history. About a month had passed since I was hatched, and I had now reached my perfect state, appearing in the reddish-brown colour and form that you now see me. My body is compressed; that is, it looks as if my sides had been squeezed together. It is covered with a hard, shining, horny skin,

in which are rows of short and sharp bristles, having their points directed backwards. You will find it rather hard work to hold me between your fingers, for my powerful legs, aided by these bristles, enable me to force my way between them a very little at a time; but still I go forward at each effort, and the bristles at the same time prevent my being forced back. You would perhaps like to hear about my mouth, as it is that which is the cause of your occasional annoyance. It is specially designed for puncturing and sucking, and is formed of various parts. My mandibles (or upper jaws) are two long, straight, narrow, transparent plates, with a double row of sharp points projecting from the surface, and then hooked backwards on each side. Each mandible strongly resembles a very minute beak, like that of the saw-fish. These fold closely together, enclosing between them a thin narrow blade, having its edge studded with a single row of glassy points. When not in use, all these are protected by certain organs called "labial palpi," which unitedly form a tubular sucking instrument. All these parts are so very small that you will require a microscope of a high power to see them distinctly.

'In my present state I have several very marked peculiarities. In the first place, I have no wings, these being represented by four very minute scales on my chest. The upper two are the rudiments of the front pair of wings, and the lower of the hinder pair; and it is owing to this that the name of my order is Aphaniptera, which signifies that the wings do not appear. I should not be surprised to hear you say that you were thankful that we have no organs of flight—very likely. But we make up for it in great measure by being very active and such wonderful jumpers; but although this is the case, we generally crawl, only using our powers of jumping in times of sudden danger. As regards our

agility and strength, there appears to be a great difference of opinion among you. First, as to agility, or distance that we can jump. One observer tells us that we can jump two hundred times our own length; but another increases it to five hundred times! A third says, "the average jump of a flea is about thirty times its own height, which is equal to a man six feet in stature jumping as high as the gallery of the Monument." Then, as to strength. Another tells us that "a flea can draw behind it a weight which is as much disproportioned to the size of its body as would be one of Pickford's largest and heaviest-laden wagons to a human being." But this is nothing compared to another writer, who says: "Fasting fleas, on an average, pull 1,493 times their own dead weight!" He is speaking of one of my performing relations. I cannot attempt to explain these differences, which are somewhat exaggerated.

'There is yet another peculiarity which has been a great puzzle to your naturalists. I have two eyes—one on each side of my head, but they are simple ones, consisting only of a single lens, like your own eyes. They are small, round, and smooth; and behind each is a cavity or depression, at the bottom of which the antennæ are attached.

'In now taking my leave, I fear you will not regret my departure; but, although I do cause you annoyance now and then, you cannot accuse me of anything worse. I have, however, a relation residing in the West Indies of whom your fellow creatures have great cause to complain. He is commonly called the Jigger or Chigoe. His mother does not select such a harmless position as the drawing-room hearthrug in which to deposit her eggs, but she places them just under the skin of the feet, the toes especially; and unless means are taken at once to get rid of them, fearful ulcers are formed, which

become so serious that I have heard that sometimes nothing but amputation can save the life of the sufferer. I have many relations in this country, but we seldom meet, for we all keep very closely to our own quarters. I think I have now told you the chief points of interest in my life-history, so will——'

Here we felt the flea struggling between our fingers, and immediately afterwards we saw a minute dark speck moving quickly through the air. The flea had flown, or rather jumped away, and where she alighted we were not able to discover.

* * * * *

And here we conclude these *Insect Lives* with the earnest hope that the young reader may be induced to study other life histories of these little and often too much despised works of the Creator, who has exhibited His almighty power in their structure, so wonderfully adapted to their various conditions of life. The more extended his studies, the more will he recognise the truth of the Psalmist's words, 'In *wisdom* hast Thou made them all'; and he will at the same time see that the wisdom and power of God are as much displayed in the creation of the minutest insect as in that of the largest animal that treads the earth. From this he may learn that nothing is beneath His notice, but that 'not one of them is forgotten before God'; and that 'His tender mercies are over *all* His works.' This should strengthen his faith, and constantly remind him that He who created them all is his Creator, in whom 'he lives, and moves, and has his being,' and has 'given him life and breath and all things' in this world; and, above all, has promised to give those who love Him life everlasting in the world to come, for His dear Son's sake.

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